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CENOMANIAN TURONIAN FORAMINIFERA
FROM KASKAPAU FORMATION
PEACE RIVER AREA
WESTERN CANADA

J.H. WALL

1951

Thesis
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#66

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CENOMANIAN TURONIAN FORAMINIFERA
FROM KASKAPAU FORMATION,
PEACE RIVER AREA, WESTERN CANADA

A DISSERTATION
SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF SCIENCE

FACULTY OF ARTS AND SCIENCE
DEPARTMENT OF GEOLOGY

by

JOHN HALLETT WALL

EDMONTON, ALBERTA
SEPTEMBER, 1951

Thesis
1951
#66

CENOMANIAN-TURONIAN FORAMINIFERA FROM KASKAPAU FORMATION, PEACE RIVER AREA, WESTERN CANADA

Preface

This research project serves to demonstrate the value of arenaceous foraminifera for detailed stratigraphic correlation work. The thesis has the following immediate objectives in view: -

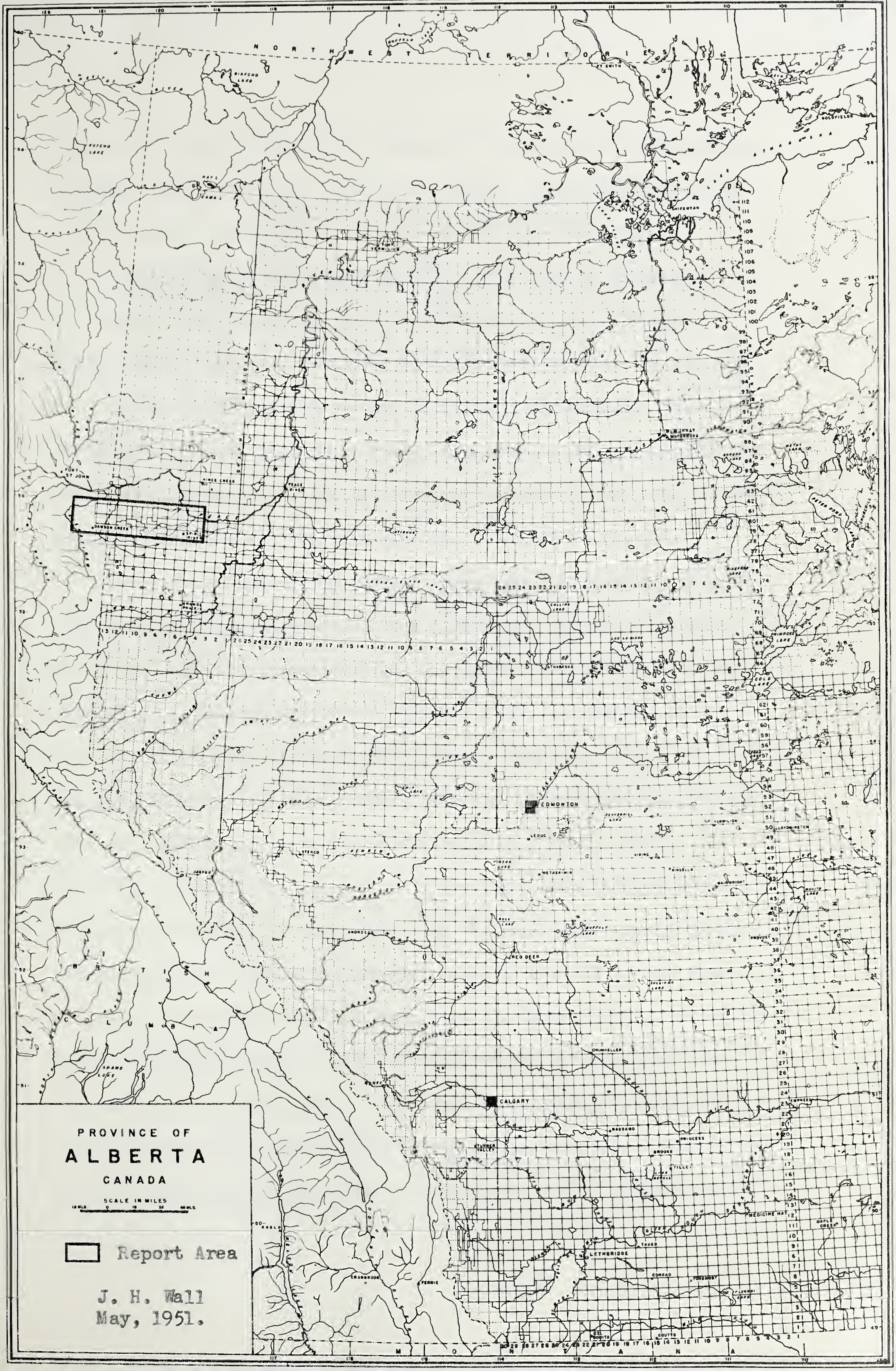
(1) The formal description of all the commonly occurring species of foraminifera in the lower part of the Upper Cretaceous Kaskapau formation in the Peace River Area of Western Canada.

(2) The microfaunal zoning of the Kaskapau formation and calibration of these zones with pelecypod and ammonite horizons recognized by Warren and Stelck, with an effort to make a more refined definition of the Cenomanian-Turonian boundary.

(3) The correlation, wherever possible, of the Kaskapau faunas of the Peace River Area with equivalent faunas in other regions of North America.

(4) The compilation of faunal sections at several localities within the Peace River Area, and the correlation of the various units in these sections over the report area.

The area covered in this report (Figure 1), located in the Peace River country of Western Canada, extends from the hamlet of Dunvegan, Alberta, on the Peace River at the eastern end of the area (Township 80, Range 4 West of the 6th Meridian) westward for approximately 80 miles to the village of Arras, British Columbia, on the


PROVINCE OF
ALBERTA
CANADA
SCALE IN MILES
Report Area
J. H. Wall
May, 1951.
NORTHWEST TERRITORIES
BRITISH COLUMBIA
MONTANA
FORT ST JOHN
DAWSON CREEK
SPIRIT RIVER
HINES CREEK
PEACE RIVER
GRANDE PRAIRIE
FORT VERMILION
FORT CHIPEWYAN
LAKE ATHABASKA
GOLDFIELDS
MCMURRAY
WATERWAYS
LESSER SLAVE LAKE
ATHABASKA
LAC LA BICHE
COLD LAKE
PRIMROSE LAKE
JASPER
EDMONTON
LEDUC
VERMILION
LLOYDMINSTER
VIKING
KINSELLA
WAINWRIGHT
PROVOST
RED DEER
DRUMHELLER
CALGARY
TURNER VALLEY
BASSANO
BROOKS
PRINCESS
MEDICINE HAT
MAPLE CREEK
LETHBRIDGE
TABER
FOREMOST
COUTTS
SWEETGRASS
CRANBROOK
FERNIE
KASLO

Kiskatinaw River (Township 78, Range 17 West of the 6th Meridian). Sporadic sample coverage exists on roughly a 20-mile north-south front between the eastern and western limits of the area.

Most of the source material for the study was obtained from an Imperial Oil Limited core-hole section near the village of Spirit River, Alberta. Outcrop sections were sampled by Imperial Oil Limited field parties at the localities of Dunvegan, Doe Creek, Pouce Coupe River, Henderson Creek, Alberta and Kiskatinaw River, British Columbia, with various sampling methods being used at the different localities (see Appendix for detailed accounts).

Some four hundred and twenty-eight (428) core hole and outcrop samples, from the central and lower parts of the Kaskapau formation, were disintegrated and examined for their microfaunal content from September 1945 to December 1950, by members of the Imperial Oil Limited Subsurface Division laboratory staff at Calgary, Alberta, and the author. Several disintegration methods were employed to break up the shale samples. Most commonly the material is soaked in a beaker of water for a day, the pieces of shale are boiled in a beaker and then the macerated sample is decanted through a series of screens, ranging from 30 to 200 mesh. The writer personally, either extracted the microfossils, or checked the original picking job of the laboratory personnel in two hundred and six (206) samples, personally checking at least once in every ten feet of the section. The better specimens were chosen for holotypes and paratypes for the fifty-five (55) species of

foraminifera herein described, and these specimens were photographed under different magnifications, ranging from forty (40) to ninety-five (95), using a Leitz Wetzlar M4B camera and a Leitz Wetzlar petrographic microscope.

With the conclusion of the preparatory work outlined above, the writer began evaluating the individual specimens obtained from the samples at the various localities (8550 specimens), making around 6560 specific identifications. The microfaunal content of each individual sample is listed (see Appendix), along with its exact stratigraphic position and lithologic description. Fifty-five (55) species are formally described, the stratigraphic range and maximum development of each is determined as far as sample coverage permits, and comparisons with other species in the same area and outside areas are noted. Microfaunal sections have been drawn up for all of the principal localities, which illustrate the division of the Kaskapau formation into the various foraminiferal zones and the resulting value of these zones in making close correlation within the area. Megafaunal and pertinent lithological data are also included. Determination of interregional correlation is outlined.

Acknowledgements

The writer has been collecting and evaluating data on this project since 1947 and it is not possible to acknowledge the work of each one, either directly or indirectly connected with the collection of the great mass of material used in the preparation of this report. There are the various personnel of the drilling crews who obtained cores; student assistants on the different field parties

who sampled shale banks; and laboratory assistants who handled the samples received at the Imperial Oil laboratory in Calgary between the fall of 1945 and the spring of 1949.

The writer wishes to thank Imperial Oil Limited, who, through Dr. Ernest W. Shaw, formerly Divisional Geologist for Western Canada, gave permission to use material for academic research, and who in January 1950, transferred the writer from Calgary to Edmonton to permit university collaboration.

The co-operation of Mr. Jim Smith, head of the Imperial Oil Limited Subsurface Division laboratory in Calgary, and his staff was excellent throughout the course of the study. Most of the Spirit River core samples were disintegrated by Fenton H. Montgomery and picked by Lloyd D. Pearson, of the laboratory staff. Re-examination of many of the samples picked by Pearson showed the original picking job to be almost complete.

Joseph Gleddie, William L. Clemis, and John Y. Smith, geologists with the Imperial Oil Surface Division, assisted the author by searching through old files and field note books, for necessary information relating to the outcrop sections sampled by the field parties under their direction.

Dr. Colin H. Crickmay, Staff Paleontologist, identified the macrofossils in the Spirit River sections; John B. Newland, Geologist with the Subsurface Division, logged the core from the Spirit River Structure Test #A-337-1; George C. McClintock, along with the writer, logged the cores from the Imperial Spirit River #1 Well.

Frederick A. Killer assisted the writer by lending photographic developing equipment, and imparting many helpful suggestions concerning photographic procedure. Miss Eunice Shaben of the Imperial Oil Geological Department in Edmonton assisted in editing the manuscript and enclosed charts.

Dr. P. S. Warren, Chairman of the Department of Geology, University of Alberta, identified the macrofossils collected by Imperial Oil surface geologists at the localities other than Spirit River.

To Dr. Charles R. Stelck, Assistant Professor of Geology at the University of Alberta, the writer wishes to acknowledge his sincere appreciation. Although the project was carried out without direct supervision from any member of the faculty, Dr. Stelck acted as adviser and devoted much time to discussions involving correlations proposed by the writer and the formal descriptions of the foraminiferal species. In addition, Dr. Stelck criticized the manuscript and did the retouching on the fossil plates.

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TABLE OF CONTENTS

Title Page ii
Preface. iii
Acknowledgments. v
Table of Contents. viii
Abstract xiii

CENOMANIAN - TURONIAN FORAMINIFERA FROM KASKAPAU FORMATION, PEACE RIVER AREA, WESTERN CANADA.

Part I. The Kaskapau Formation.

Terminology. 1
Distribution, General Lithology, Thickness 2
Stratigraphic Paleontology of the Lower and Central Parts of the Kaskapau Formation. 3
  Previous Work. 3
  Spirit River Area. 3
    Lithology. 4
    Macropaleontology. 5
    Micropaleontology. 5
  Dunvegan Area. 11
    Lithology. 11
    Macropaleontology. 11
    Micropaleontology. 11
  Pouce Coupe River Area 13
    Lithology. 13
    Macropaleontology. 13
    Micropaleontology. 14
  Kiskatinaw River Area. 19
    Lithology. 19
    Macropaleontology. 19
    Micropaleontology. 19

Part II. Correlation of the Central and Lower Parts of the Kaskapau Formation.

Cenomanian - Turonian Boundary 21
Local Correlation. 22
  Correlation of Pouce Coupe and Spirit River Area Sections 22
    The Pouce Coupe Sand 27
  Correlation of Spirit River and Dunvegan Area Sections 28
    The "Spirit River" Sand at the Dunvegan Locality . . 29

Part II (continued)

Correlation of Pouce Coupe and Kiskatinaw River Area Sections 31
Regional Correlation. 32
Central and Southern Alberta Foothills. 32
Central Alberta Plains (Edmonton Area). 32
East Central Alberta Plains (Vermilion Area). 33
Southern Alberta and Southern Saskatchewan. 34
Southern Manitoba 34
Southern Montana. 35
Rocky Mountain Region of the United States. 35
Texas 35

Part III The Foraminiferal Faunas of the Central and Lower Parts of the Kaskapau Formation.

Nomenclature. 37
Ecology 39
Upper Cenomanian Microfauna 39
Lower Turonian Haplophragmoides ST-664-A Microfauna . 41
Lower Turonian Pelagic Microfauna 42

Formal Descriptions.

Genus: Ammobaculites 44
Ammomarginulina 52
Dorothia. 55
Flabellammina 57
Gaudryina 69
Globigerina 73
Gumbelina 74
Gumbelitria 76
Haplophragmoides. 80
Proteonina. 103
Spiroplectammina. 104
Textularia. 106
Tritaxia. .109
Trochammina 111
Verneuilina 121

Illustrations of Microfauna

Plate I. Upper Cenomanian Foraminifera from lower part of Kaskapau Formation . . . . ff. page 123
Explanation of Plate I. 124
Plate II. Upper Cenomanian Foraminifera from lower and central parts of Kaskapau Formation . . . ff. page 126
Explanation of Plate II 127
Plate III. Lower Turonian Foraminifera from central part of Kaskapau formation. . . . . ff. page 131
Explanation of Plate III. 132

Appendix Page

Appendix I - Identification of Foraminifera by Localities.

Part I - Spirit River Localities 1
    Section A - Foraminiferal Analysis of the Lower Turonian and Upper Cenomanian Beds of the Imperial Spirit River Structure Test Hole #A-337-1 2
    Section B - Foraminiferal Analysis of the Upper Cenomanian Beds of the Imperial Spirit River #1 Well. 30

Part II - Dunvegan Localities 38
    Section A - Foraminiferal Identifications in the Upper Cenomanian Beds of the Imperial Oil Limited Surface Division Localities S47-27 and S47-28. 39
    Section B - Foraminiferal Identifications in the Upper Cenomanian Beds of the Imperial Oil Limited Surface Division Locality C47-9. 40

Part III - Doe Creek Localities. 42
    Section A - Foraminiferal Identifications in the Upper Cenomanian Beds of the Imperial Oil Limited Surface Division Locality G45-5. 43
    Section B - Foraminiferal Identifications in the Upper Cenomanian Beds of the Imperial Oil Limited Surface Division Locality S47-4. 47

Part IV - Pouce Coupe River Localities. 55
    Section A - Foraminiferal Identifications in the Uppermost Cenomanian Beds of the Imperial Oil Limited Surface Division Localities G45-6 and G45-19. 56
    Section B - Foraminiferal Identifications in the Upper Cenomanian Beds of the Imperial Oil Limited Surface Division Locality G45-18 .58

Appendix I (continued) Appendix Page

Part V - Henderson Creek Localities. 60
Foraminiferal Identifications in the Beds of the Imperial Oil Limited Surface Division Localities G45-3 and G45-4. 61

Part VI - Kiskatinaw River Localities 65
Foraminiferal Identifications in the Beds of the Imperial Oil Limited Surface Division Localities S47-35 and S47-36 66

Appendix II - Bibliography. 70

List of Figures

Figure 1 - Map of Province of Alberta showing Location of Report Area . . . . ff. page iii

Figure 2 - Lower Part of Kaskapau Formation, Spirit River Area . . . . .ff. page 3

Figure 3 - Central Part of Kaskapau Formation, Spirit River Area . . . . .ff. page 8

Figure 4 - Lower Part of Kaskapau Formation, Dunvegan Area . . . . .ff. page 11

Figure 5 - Lower Part of Kaskapau Formation, Pouce Coupe Area. . . . . .ff. page 13

Figure 6 - Central Part of Kaskapau Formation, Pouce Coupe Area. . . . . .ff. page 16

Figure 7 - Central Part of Kaskapau Formation, Kiskatinaw River Area . . . . .ff. page 19

Figure 8 - Major Correlation Points in the Central and Lower Parts of the Kaskapau Formation in the Peace River Area of Western Canada . . . . .ff. page 22

Figure 9 - Localities of Microfaunal Suites in Western Peace River Area. . . . . ff. page 134

Table - Relative Abundance of Foraminiferal Groups in the Central and Lower Parts of the Kaskapau Formation at Spirit River, Alberta. . . . . .in pocket

. . . . .

ABSTRACT

Fifty-five species (or varieties) of Foraminifera from the Upper Cretaceous Kaskapau formation of the Peace River Area of Western Canada are described and figured, including fifteen genera (12 arenaceous, 3 calcareous) and forty-eight species (44 arenaceous, 4 calcareous).

The species and varieties described include: 5 species of Ammobaculites; 2 of Ammomarginulina; 2 of Dorothia; 9 species and 1 variety of Flabellammina; 2 species of Gaudryina; 1 species of Globigerina; 1 species of Gumbelina; 2 species and 1 variety of Gumbelitria; 13 species and 2 varieties of Haplophragmoides; 1 species of Proteonina; 1 species of Spiroplectammina, 2 species of Textularia; 1 species and 1 variety of Tritaxia; 5 species and 1 variety of Trochammina; 1 species and 1 variety of Verneuilina.

Five microfaunal zones are set up for the "central" and "lower" parts of the Kaskapau formation, with the guide and index Foraminifera of each zone listed at the Alberta localities of Spirit River, Dunvegan, Pouce Coupe and the British Columbia locality of Kiskatinaw River. The Kaskapau is regionally correlated with formations of Colorado age in Western Canada, the Northern Plains and Rocky Mountain Regions of the United States, and Texas. The name "Spirit River" is introduced for a sandstone bed of slightly younger age than the Pouce Coupe sandstone member at Spirit River. A more refined definition of the Cenomanian-Turonian boundary is offered, that is at a footage of 23 above the "Spirit River" sand. There is a sharp transition in ecology reflected in the change from shallow water faunas of the Cenomanian to deeper water and pelagic faunas of the Turonian stage.

. . . .

CENOMANIAN-TURONIAN FORAMINIFERA FROM KASKAPAU FORMATION PEACE RIVER AREA, WESTERN CANADA

Part I - THE KASKAPAU FORMATION

Terminology

The formational name "Smoky River" was first used by G. M. Dawson in 1879, for the "upper dark shales" exposed on Smoky River. In 1918, F. H. McLearn subdivided this formation into three members, namely the "Lower shale", "Bad Heart Sandstone", and "Upper shale". In 1926, McLearn assigned the name "Kaskapau" to the Lower shale member. Gleddie, in 1949, (p. 517) proposed that, where applicable, "the name Smoky River be raised to group rank to include in ascending order the Kaskapau, Cardium, and Wapiabi formations".

The writer uses the additional terms, "lower part" and "central part" when referring to the two portions of the Kaskapau formation, featured in this study, and the term "upper part" for that portion not studied.

The "lower part" includes the section between the top of the underlying Dunvegan formation and the base of the Pouce Coupe sandstone.

The "central part" refers to the sediments from the top of the Pouce Coupe sandstone to the top of the Lower (Second) White Speckled Shale horizon (In the western part of the report area, the latter horizon is not known as a field marker).

The "upper part" includes that portion of the section between

the Lower White Speckled Shale horizon and the Bad Heart sandstone of the Spirit River and Smoky River Areas.

The "lower" and "central" parts of the Kaskapau formation may be divided into the following microfaunal zones: -

	"Central" Kaskapau	Pelagic Microfaunal zone (Lower or Second White Speckled Shale)
		Haplophragmoides ST-664-A zone (includes "white chalcedonic bed")
Cenomanian Turonian	- - - - - - - -	- - - - - - - - - - - - - - - - - - - -
		Ammobaculites ST-747-A zone (includes "Spirit River" Sand)
	"Lower" Kaskapau	Gaudryina ST-876-A zone (includes Pouce Coupe Sand at top and Doe Creek Member near base)
		Ammobaculites ST-930-A zone

Distribution, General Lithology, Thickness

The shales of the Kaskapau formation underlie the entire report area and constitute the bedrock throughout most of it.

Detailed lithologic sections are given in the appendix, but in summary, most of the formation consists of medium to dark grey, marine shales. The "lower part" of the formation, referred to by Gleddie and others as the "basal transitionary zone", including Doe Creek and Pouce Coupe sandstone members (Warren and Stelck, 1940) consists of brackish to marine shale, silty shale, sandstone, and a little ironstone. Considerable ledge-forming ironstone appears in the uppermost beds of the formation in the Pouce Coupe, Spirit River, and Smoky River Areas.

Gleddie (1949, p. 521) gives an approximate thickness of 1550 feet for the formation near Pouce Coupe and 900 feet in the vicinity of Spirit River. More recent subsurface work in the latter area

suggests an overall thickness of about 1100 feet. In the Smoky River Area, J. Y. Smith (Gleddie, ibid.) reports a thickness ranging from 520 to 600 feet.

Stratigraphic Paleontology of the Lower and Central Parts of the Kaskapau Formation

Previous Work

The only previous foraminiferal work in the Kaskapau is that of C. R. Stelck (1950), who in an unpublished work, describes forty-nine forms from surface sections at Kiskatinaw River, British Columbia and at Doe Creek and Dunvegan, Alberta. Some of these forms are rather rare and limited in value for correlation work. However, there are others, which the writer observed to be very useful stratigraphically, and these are included in this study.

Since this report deals with foraminifera, the writer does not outline the macropaleontological and geological work done on the Kaskapau formation. The megafauna has been surveyed by F. H. McLearn, P. S. Warren, and C. R. Stelck. The more recent published reports dealing with general geology are those of R. L. Rutherford (1930), and J. Gleddie (1949).

Spirit River Area

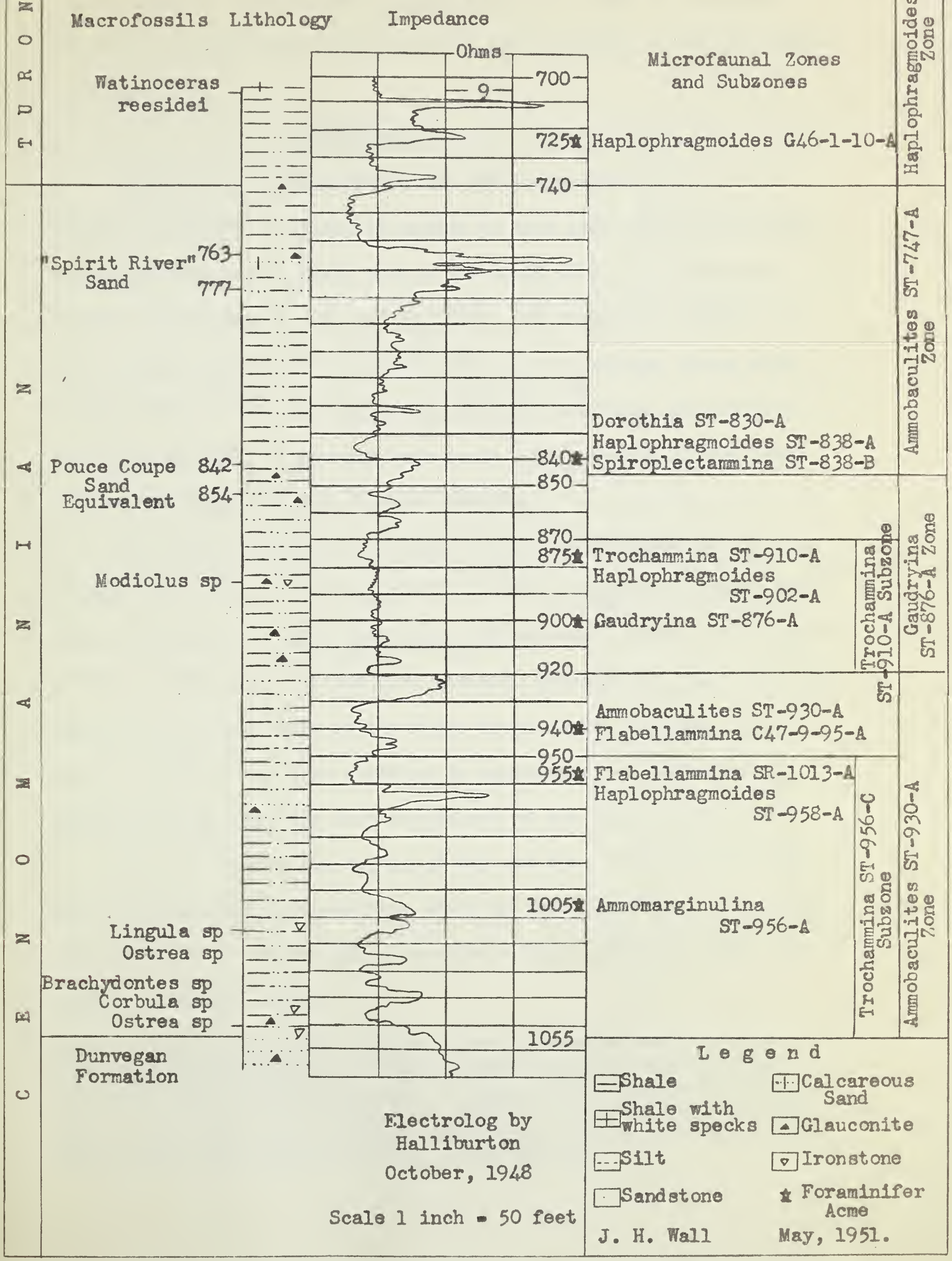
The most important section studies is at Spirit River, as the entire interval from the Lower (Second) White Speckled Shale to the Dunvegan was cored at either the Spirit River Structure Test #A-327-1 or the Imperial Spirit River #1 Well. The writer used the cored section for setting up the various microfaunal zones discussed in the report. Figure 2 is a summary of the microfaunal, megafaunal, lithological, and electrolog data of the sediments from the lower part of

SPIRIT RIVER AREA

FIG. 2

LOWER PART OF KASKAPAU FORMATION

Subsurface Section I.O.L. Structure Test #A-337-1
" " " Spirit River #1 Well
Tp. 78, Rge. 6 and 7 W-6th Meridian, Alberta.


TURONIAN
CENOMANIAN
Macrofossils
Lithology
Impedance
Ohms
9
Microfaunal Zones and Subzones
Watinoceras reesidei
"Spirit River" Sand
763
777
Pouce Coupe Sand Equivalent
842
854
Modiolus sp
Lingula sp
Ostrea sp
Brachydontes sp
Corbula sp
Ostrea sp
Dunvegan Formation
700
725
740
840
850
870
875
900
920
940
950
955
1005
1055
Haplophragmoides G46-1-10-A
Dorothia ST-830-A
Haplophragmoides ST-838-A
Spiroplectammina ST-838-B
Trochammina ST-910-A
Haplophragmoides ST-902-A
Gaudryina ST-876-A
Ammobaculites ST-930-A
Flabellammina C47-9-95-A
Flabellammina SR-1013-A
Haplophragmoides ST-958-A
Ammomarginulina ST-956-A
Haplophragmoides ST-664-A Zone
Ammobaculites ST-747-A Zone
Trochammina ST-910-A Subzone
Gaudryina ST-876-A Zone
Trochammina ST-956-C Subzone
Ammobaculites ST-930-A Zone
Legend
Shale
Shale with white specks
Silt
Sandstone
Calcareous Sand
Glauconite
Ironstone
★ Foraminifer Acme

Electrolog by
Halliburton
October, 1948

Scale 1 inch = 50 feet

J. H. Wall May, 1951.

the Kaskapau at the two above locations, while Figure 3 summarizes the same data from the central part of the formation at the Structure Test hole.

Lithology

Between the depths* of 400 and 740 feet, the section of the Kaskapau formation consists of medium to dark grey shale, calcareous white speckled to 700 feet, with a few small silt and sand lenses. Between the depths of 740 and 1055 feet, the formation consists of medium grey, sandy to silty shale with pyrite tracings, along with several beds of buff and grey, fine-grained sandstone, glauconitic and shaly in part. Sandstone beds occur more commonly in the basal 135 feet of the formation at this locality.

The writer introduces the name "Spirit River" sand for the bed of buff-grey, fine to medium grained, partly glauconitic, shaly sandstone (calcareous in uppermost foot), which occurs between the depths of 763 and 777 feet. It has been assumed, erroneously, that this sand might be the correlative of the Pouce Coupe member, because it is better developed and more striking in appearance, as reflected on the electrolog, than the sand equivalent of the Pouce Coupe member.

The bed between the depths of 842 and 854, consisting of buff-grey, fine-grained, glauconitic, shaly in part, sandstone is now considered to be the equivalent of the Pouce Coupe sandstone member for reasons discussed later.

---

* Depths used in manuscript, unless stated otherwise, refer to the Structure Test #A-337-1. The actual total depth of this hole was 970 feet, but in order to be able to speak of one continuous section down to the top of the Dunvegan, a projected depth of 1055 was calculated for this marker. Exact correlation with the Imperial Spirit River #1 Well was made by the use of electrologs.

Macropaleontology

Between footages of 5 and 10 above the contact with the underlying Dunvegan, Dr. Crickmay and the writer noted the occurrences of Brachydontes sp., Corbula sp., and Ostrea sp. Specimens of Corbula sp. are numerous over the short interval from 5 to 8 feet, above the Dunvegan-Kaskapau contact. Between the extreme basal portion of the formation and the beds around the 700 foot level, there appears to be little in the way of diagnostic megafossils.

The first indication of Lower Turonian age comes between the depths of 700 and 710 feet, where Watinoceras sp. was observed, while 20 to 40 feet above this horizon, Dr. Crickmay recorded Inoceramus sp., Scaphites delicatulus Warren, and Watinoceras cf. reesidei Warren. Upwards from this horizon to the top of the Lower White Speckled Shale, several specimens of Inoceramus sp. and Watinoceras sp. were noted.

Micropaleontology

The writer has subdivided the lower and central parts of the Kaskapau into five microfaunal zones, which in ascending order are Ammobaculites ST-930-A, Gaudryina ST-876-A, Ammobaculites ST-747-A, Haplophragmoides ST-664-A, and the Pelagic Microfaunal Zone (Gumbelina, Globigerina). The boundaries and foraminiferal content of each of the above five zones and of the subzones within these are listed: -

THE AMMOBACULITES ST-930-A ZONE comprises the basal 135 feet of the Kaskapau formation at Spirit River, with the lower 105 feet

of the interval in turn being assigned to the Trochammina ST-956-C subzone.

The following six species are restricted to the A. ST-930-A zone:-

Ammomarginulina ST-956-A
Flabellammina SR-1013-A
" SR-1011-A
Flabellammina C47-9-95-A
" ST-937-A
Trochammina S47-4-186-A★

The following three species are only rarely found above the top of the zone: -

Ammobaculites ST-930-A
Haplophragmoides G45-5-85-A★★
Proteonina SR-1034-A★★

The following four species have their acmes within the A.ST-930-A zone and do not occur commonly above it: -

Ammomarginulina ST-956-B
Haplophragmoides ST-958-A
Trochammina ST-956-C
" ST-892-A

The group of species listed below occurs more or less commonly in the zone but also range somewhat higher stratigraphically: -

Haplophragmoides SR-1018-B
" SR-1011-B
" ST-850-A
Textularia G45-5-220-A
Gaudryina SR-1018-A
" ST-876-A
Verneuilina SR-1009-A
" G45-5-110-C

The Trochammina ST-956-C subzone embraces the lower 105 feet of sediments, in which Trochammina ST-956-C is the most commonly occurring fossil, with the top of the subzone being placed at the footage above the Dunvegan, where the form noticeably weakens. This point is about 10 feet below the footage where Ammobaculites ST-930-A and Flabellammina C47-9-95-A reach their acmes.

★ A rare species in this area.

★★ the single identifications of these forms above the zone are questionable.

THE GAUDRYINA ST-876-A ZONE occupies a 78 foot interval between the top of the Ammobaculites ST-930-A zone (920 feet) and the top of the Pouce Coupe member equivalent (842 feet), that is, between footages of 135 to 213 above the Dunvegan. The lower 50 feet of this interval is in turn assigned to the Trochammina ST-910-A subzone.

There are no species restricted to this zone, but the following forms, although occurring also in the underlying Ammobaculites ST-930-A zone, are not found above the top of the Gaudryina ST-876-A zone: -

Gaudryina SR-1018-A
" ST-876-A

Verneuilina SR-1009-A
" G45-5-110-C

These two species, not present in the Ammobaculites ST-930-A zone, attain their acmes in the Gaudryina ST-876-A zone, and are not commonly found above it: -

Haplophragmoides ST-902-A

Trochammina ST-910-A

The group of species listed below occurs more or less commonly in the zone, but also range somewhat higher stratigraphically: -

Haplophragmoides SR-1018-B
" SR-1011-B
" ST-850-A
" ST-740-A*

Ammobaculites G45-19-0-A*
Spiroplectammina ST-838-B
Textularia G45-5-220-A

The Trochammina ST-910-A subzone includes the lower 50 feet of the greater zone and is characterized by two "floods" of the species, one at the base and the other about 5 feet from the top of the subzone, the latter being particularly noticeable in the samples.

* found only in the upper 10 to 15 feet of this zone - they are normally associated with the overlying Ammobaculites ST-747-A zone

THE AMMOBACULITES ST-747-A ZONE occupies an interval of 102 feet between the top of the Pouce Coupe sandstone equivalent (842 feet) and the base of the Haplophragmoides ST-664-A zone (740 feet), its (A. ST-747-A) upward limit being taken by the writer as the line of division between the Cenomanian and Turonian stages.

The following species are confined to this zone: -

Ammobaculites ST-747-A
" ST-745-A
Dorothia ST-830-A
" ST-834-A
Gumbelitria ST-782-A*
Haplophragmoides ST-838-A
Textularia ST-747-A
Trochammina ST-812-A

The following 3 forms, although occurring infrequently in the upper part of the underlying Gaudryina ST-876-A zone, have their acmes in the Ammobaculites ST-747-A zone, and are not found above it:-

Ammobaculites G45-19-0-A
Haplophragmoides ST-740-A
Spiroplectammina ST-838-B

The group of species listed below occur more or less commonly in this zone, and although they have been identified from the underlying zone or zones, they do not appear in the overlying Haplophragmoides ST-664-A zone: -

Haplophragmoides SR-1018-B
" SR-1011-B
" ST-850-A
Haplophragmoides ST-902-A
Trochammina ST-910-A

The following group of forms occurs more or less commonly in this zone, but also range somewhat higher stratigraphically: -

Gumbelitria cretacea
" ST-596-A
Haplophragmoides ST-664-A
Tritaxia ST-664-B

---

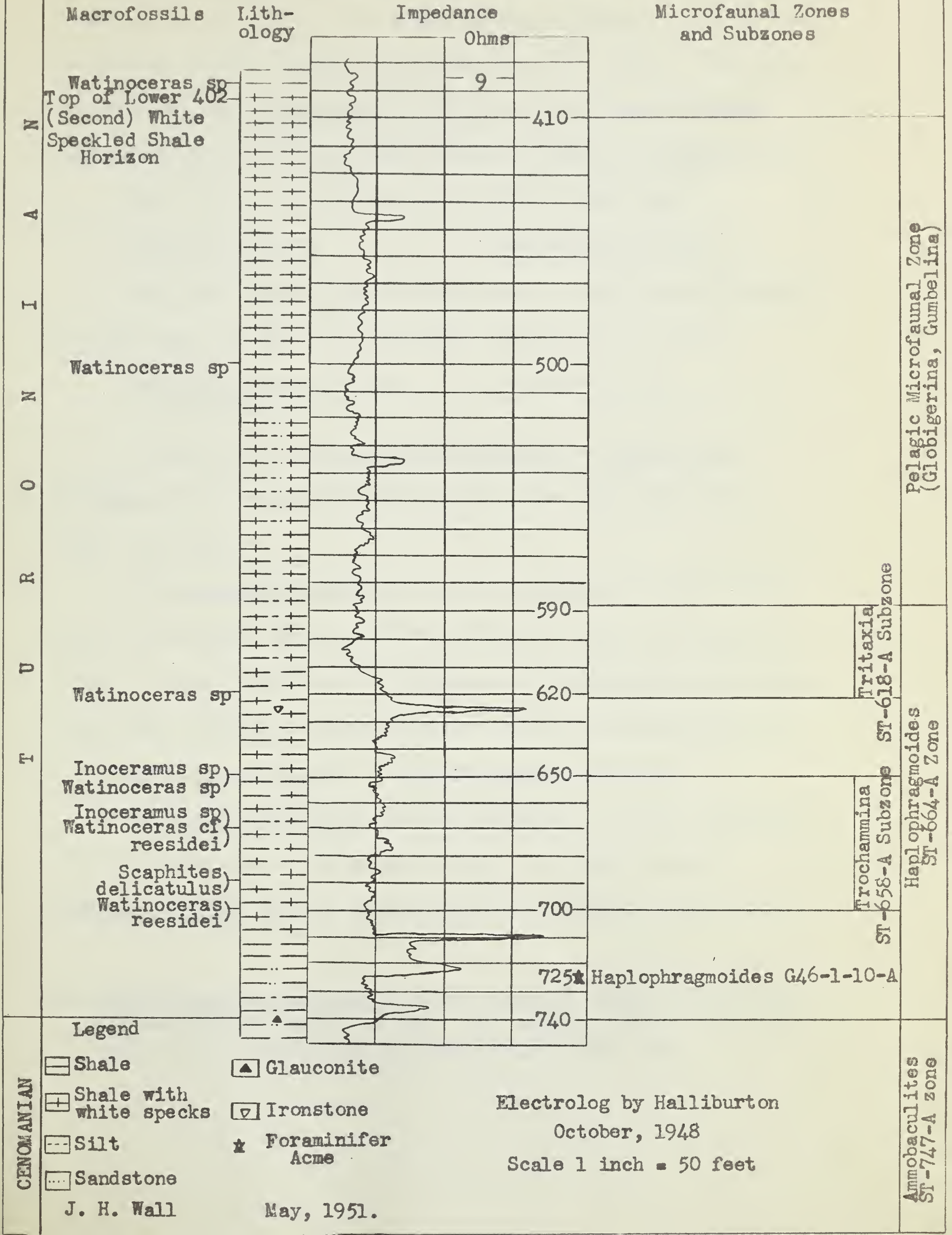
* There is one isolated occurrence of this species in the Ammobaculites ST-930-A zone.

SPIRIT RIVER AREA FIG. 3

CENTRAL PART OF KASKAPAU FORMATION

Subsurface Section I.O.L. Structure Test #A-337-1

Tp. 78, Rge. 7 W-6th Meridian, Alberta



Electrolog by Halliburton
October, 1948
Scale 1 inch = 50 feet

J. H. Wall

May, 1951.

THE HAPLOPHRAGMOIDES ST-664-A ZONE occupies a 150 foot section, extending from the top of the *Ammobaculites ST-747-A* zone (740 feet) to the base of the Pelagic Microfaunal zone (590 feet). There are two subzones, the *Trochammina ST-658-A* and the *Tritaxia ST-618-A* included in the central and upper parts of this zone respectively.

There are only two forms restricted[*] to this zone: -

Tritaxia ST-618-A
Trochammina ST-658-A

Two other species, which occur commonly and characteristically in this zone, but which are not wholly confined to it, are: -

Haplophragmoides ST-664-A (numerous)
Tritaxia ST-664-B

In addition, both *Gumbelitria cretacea* and *Gumbelitria ST-596-A* occur rather frequently in this zone, but range both above and below it.

The *Trochammina ST-658-A* subzone, occupying a 50 foot interval, from footages of 40 to 90 feet above the base of the greater zone, is characterized by the predominance of *Trochammina ST-658-A*, which very noticeably overshadows the combined representation of both *Gumbelitria cretacea* and *Haplophragmoides ST-664-A*.

The *Tritaxia ST-618-A* subzone, occupying a 30 foot interval at the extreme top of the greater zone, is so named because *Tritaxia ST-618-A* has not been recognized outside of these limits.

---

[*] *Haplophragmoides G46-1-10-A* occurs commonly about 10 feet above the base of this zone, but there also appears to be a few occurrences in the underlying *Ammobaculites ST-747-A* zone.

THE PELAGIC MICROFAUNAL ZONE, so named, because of the abundance of the pelagic genera, Gumbelina and Globigerina, occupies a 180 foot interval from the top of the Haplophragmoides ST-664-A zone (590 feet) to within 8 feet of the top of the Lower (Second) White Speckled Shale horizon (410 feet).

Globigerina cretacea d'Orbigny and Gumbelina globulosa (Ehrenberg) are restricted to this zone and occur abundantly.

Gumbelitria cretacea Cushman and Gumbelitria ST-596-A, the former occurring abundantly, are found in this zone but are by no means confined to it.

The zone is strikingly devoid of any arenaceous forms, with a total of only eight specimens of Haplophragmoides being found over the interval.

Dunvegan Area

Figure 4 gives a summary of the known lithological, megafaunal, and microfaunal information of the Dunvegan Area. It will be seen that the sample coverage is unfortunately incomplete.

Lithology

A sand bed at this locality, which is being correlated with the "Spirit River" member, consists of soft, fine-grained sand, intermixed with shale and sandy shale in the lower 4 feet, the overall thickness for the bed being 9 feet.

The only detailed lithological descriptions available here are for the samples collected over intervals of 13 and 16 feet above and below the top and the base respectively of the "Spirit River " equivalent, such samples being reported as grey, silty to sandy shale, being especially sandy in the lower part.

Macropaleontology

Only two megafossils were identified at this locality, with Arctica sp. being identified in the "Spirit River" equivalent, and Dunveganoceras cf. albertense (Warren) being identified by Dr. P. S. Warren from a footage of about 155 above the Dunvegan-Kaskapau contact.

Micropaleontology

The writer was able to recognize elements of three of the microfaunal zones established at Spirit River. In ascending order, they are the Ammobaculites ST-930-A, Gaudryina ST-876-A, and Ammobaculites ST-747-A zones, with the faunal content of each following: -

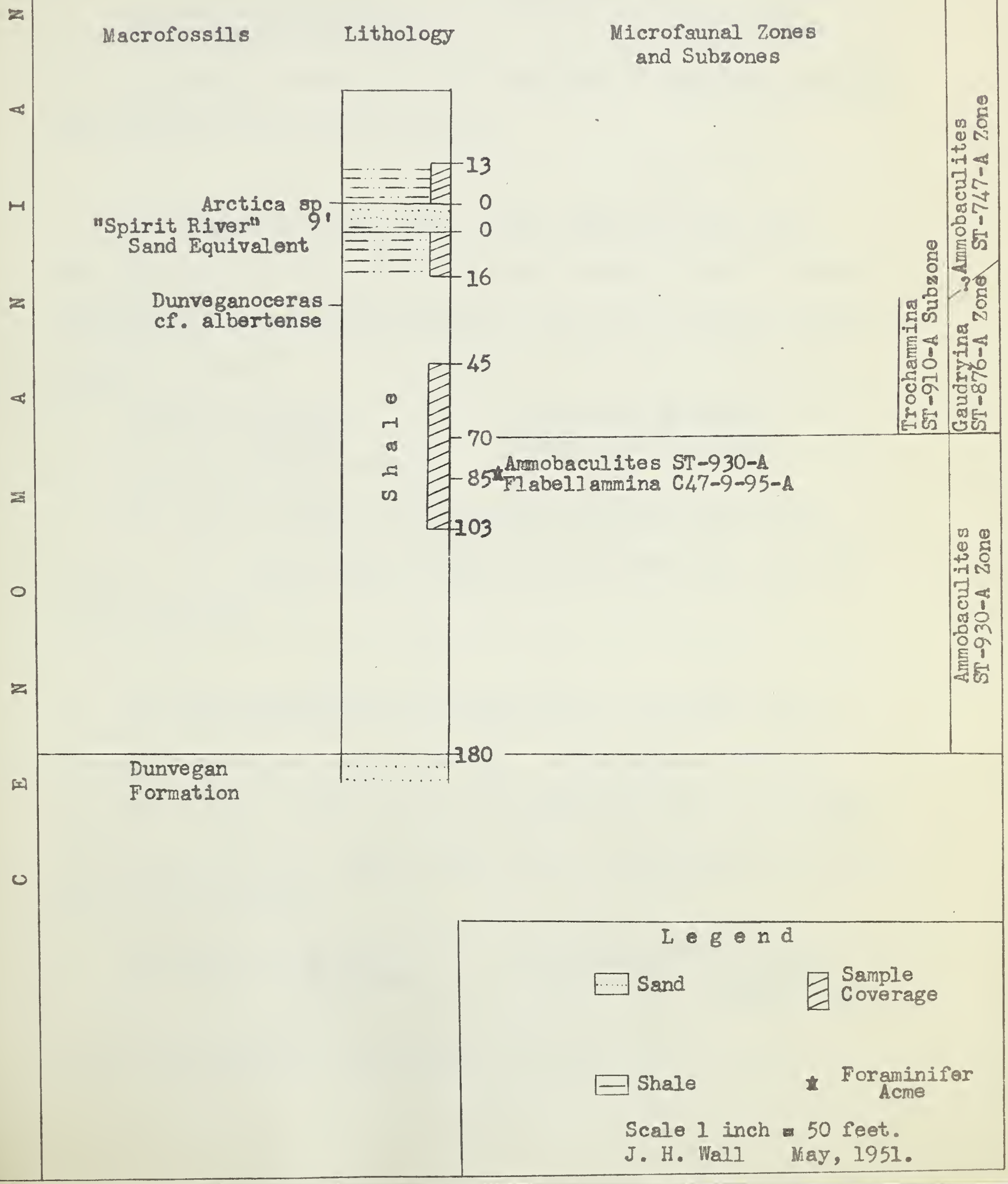
DUNVEGAN AREA

FIG. 4

LOWER PART OF KASKAPAU FORMATION

Surface Section - Localities S47-27, S47-28
" " - Locality C47-9

Tp. 80, Rge. 4 and 5 W-6th Meridian, Alberta


C E N O M A N I A N
Macrofossils
Lithology
Microfaunal Zones and Subzones
Arctica sp
"Spirit River" Sand Equivalent
9'
Dunveganoceras cf. albertense
Shale
13
0
0
16
45
70
85
103
180
Ammobaculites ST-930-A
Flabellammina C47-9-95-A
Trochammina ST-910-A Subzone
Gaudryina ST-876-A Zone
Ammobaculites ST-747-A Zone
Ammobaculites ST-930-A Zone
Dunvegan Formation
Legend
Sand
Sample Coverage
Shale
Foraminifer Acme

Scale 1 inch = 50 feet.
J. H. Wall May, 1951.

THE AMMOBACULITES ST-930-A ZONE occupies the basal 110 feet of the Kaskapau at the Dunvegan locality. Forms not found above it include: -

Ammobaculites ST-930-A
Flabellammina C47-9-95-A
Flabellammina SR-1013-A*
" G45-5-105-B*

In addition, nearly all of the specimens of *Trochammina ST-956-C* were found below the top of the zone.

THE GAUDRYINA ST-876-A ZONE is only partially known here. The upper limit of this zone is not known because of lack of sample coverage, but the following distinctive forms were recorded from the samples collected: -

Gaudryina SR-1018-A
" ST-876-A
Haplophragmoides ST-902-A
Trochammina ST-910-A
Verneuilina SR-1009-A

The writer includes the *Trochammina ST-910-A* subzone here, because of the concentration of this form, 125 feet above the base of the Kaskapau.

THE AMMOBACULITES ST-747-A ZONE cannot be outlined as yet because of inadequate sample coverage. In two samples, taken at footages of 2 and 7 above the top of a sand bed, which is tentatively correlated with the "Spirit River" sand, the following distinctive forms were identified: -

Ammobaculites ST-747-A
" G45-19-0-A
Haplophragmoides ST-740-A
" ST-838-A*
" G46-1-10-A*

* only one specimen of each found.

Pouce Coupe River Area

Doe Creek, Henderson Creek and Pouce Coupe River localities are all grouped together for discussion here. The individual localities are treated separately in the appendix. Two charts have been drafted to summarize the pertinent faunal and lithological data for this area (Figures 5 and 6) to cover the lower and central parts respectively of the Kaskapau.

Lithology

No detailed description is available for the beds from the upper part of the Kaskapau formation, but the lower part has been logged in detail (see Appendix)

The Pouce Coupe sandstone member, at its type locality, consists of yellow, massive, fine-grained, clean, sandstone, approximately 30 feet in thickness. The top of the sand is about 300 feet above the base of the Kaskapau.

The Doe Creek sandstone member, at its type locality, consists of yellow, fine-grained sandstone, argillaceous toward the base, approximately 6 feet in thickness. The top of the sand is 75 feet below the base of the Pouce Coupe and about 225 feet above the base of the Kaskapau.

The sections between the two sand members and between the Doe Creek and the Dunvegan, is made up chiefly of silty to sandy shale, with occasional bands of siltstone, sandstone, and ironstone.

Macropaleontology

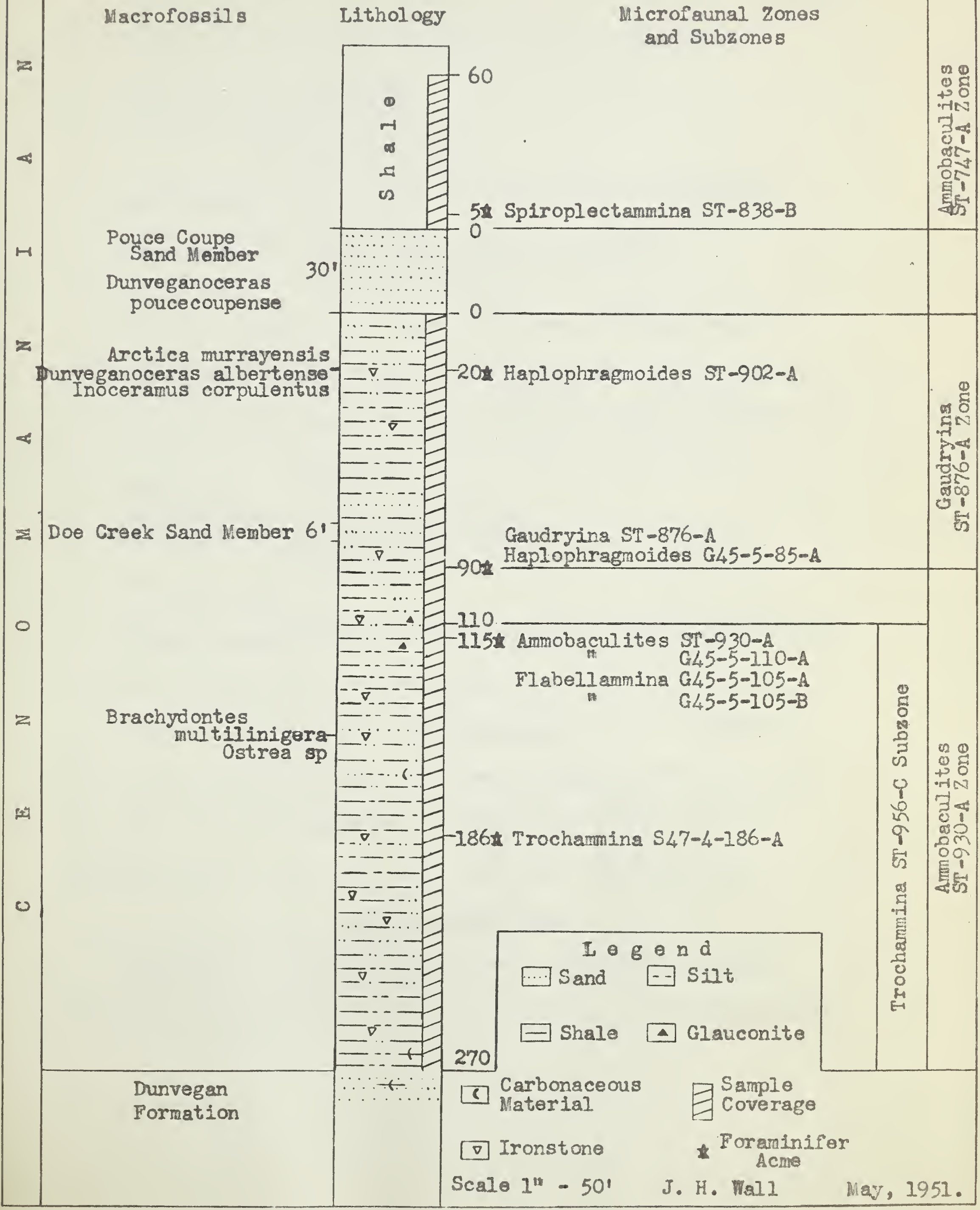
Most of the macrofossils were collected in this area by J. Gleddie and all were identified by Dr. P. S. Warren.

POUCE COUPE AREA FIG. 5

LOWER PART OF KASKAPAU FORMATION

Surface Sections - Doe Creek Localities G45-5, S47-4
" " - Pouce Coupe River Localities G45-6, G45-18, G45-19

Tps. 80, 81, Rge. 13 W-6th Meridian, Alberta
Tp. 79, Rge. 14 W-6th Meridian, British Columbia


CENOMANIAN
Macrofossils
Lithology
Microfaunal Zones and Subzones
Shale
60
5★ Spiroplectammina ST-838-B
Ammobaculites ST-747-A Zone
Pouce Coupe Sand Member
30'
Dunveganoceras poucecoupense
0
0
Arctica murrayensis
Dunveganoceras albertense
Inoceramus corpulentus
20★ Haplophragmoides ST-902-A
Gaudryina ST-876-A Zone
Doe Creek Sand Member 6'
Gaudryina ST-876-A
Haplophragmoides G45-5-85-A
90★
110
115★ Ammobaculites ST-930-A
" G45-5-110-A
Flabellammina G45-5-105-A
" G45-5-105-B
Brachydontes multilinigera
Ostrea sp
186★ Trochammina S47-4-186-A
Trochammina ST-956-C Subzone
Ammobaculites ST-930-A Zone
270
Dunvegan Formation
Legend
Sand
Silt
Shale
Glauconite
Carbonaceous Material
Sample Coverage
Ironstone
★ Foraminifer Acme

Scale 1" - 50' J. H. Wall May, 1951.

At a footage of 120 above the Dunvegan, Brachydontes multilinigera Meek and Ostrea sp. were recorded.

Either within the Pouce Coupe sand or from a few feet below it, the following group of Upper Cenomanian age was identified: -

Pelecypoda
Inoceramus allani Warren
" tenuimbonatus Warren
" corpulentus McLearn
" " var. a. and b. Warren and Stelck
Arctica murrayensis Warren
Ammomoidea
Dunveganoceras poucecoupense Warren and Stelck
" albertense (Warren)

The first indication of Lower Turonian assemblage occurs at a footage of about 25 above the "white chalcedonic bed" or 225 feet above the Pouce Coupe sand where the following suite was identified: -

Pelecypoda
Oxytoma sp.
Inoceramus cf. labiatus Schlotheim
Placenticeras pseudoplacanta Hyatt
Gastropoda
Turritella sp.

Inoceramus labiatus was identified from an horizon approximately 100 feet higher than the above suite.

Finally, Inoceramus sp. and Watinoceras sp. were picked up about 20 feet above the top of the section sampled for microfossil work, that is, at an approximate footage of 170 above the "white chalcedonic bed" or 370 feet above the Pouce Coupe sandstone.

Micropaleontology

Elements of four microfaunal zones, established at Spirit River, were recognized in the Pouce Coupe Area. In ascending order,

they are the *Ammobaculites ST-930-A*, *Gaudryina ST-876-A*, *Ammobaculites ST-747-A*, and *Haplophragmoides ST-664-A* zones, with the foraminiferal content of each listed: -

THE AMMOBACULITES ST-930-A ZONE occupies the basal 180 feet of the Kaskapau, with the lower 160 feet of it in turn being assigned to the *Trochammina ST-956-C* subzone. The top of the greater zone is not too well defined and possibly should be dropped 20 feet to coincide with the top of the subzone. The following foraminifera at Doe Creek are restricted to this zone: -

Flabellammina G45-5-105-A
" G45-5-105-B
Ammomarginulina ST-956-B
Verneuilina G45-5-110-C

The following species have their maximum development in this zone but rarely to occasionally are found above it: -

Ammobaculites ST-930-A
" G45-5-110-A
Trochammina ST-956-C
" ST-892-A
" S47-4-186-A
Flabellammina SR-1013-A
" ST-937-A
" G45-5-115-A
" G45-5-110-B*
Haplophragmoides G45-5-85-A*

The following species are found in this zone but also range somewhat higher stratigraphically: -

Gaudryina SR-1018-A
" ST-876-A
Haplophragmoides ST-958-A
Textularia G45-5-220-A
Verneuilina SR-1009-A

---

* Acmes of these forms are on the borderline between this zone and the overlying *Gaudryina ST-876-A* zone.

THE GAUDRYINA ST-876-A ZONE occupies a 120 foot interval from the top of the *Ammobaculites ST-930-A* zone to the top of the Pouce Coupe sand. Possibly its base should be dropped 20 feet to coincide with the top of the *Trochammina ST-956-C* subzone. A rather weak microfauna was recovered from the *Gaudryina ST-876-A* zone at Doe Creek, and it appears that there were a few more forms carried over from the underlying *Ammobaculites ST-930-A* zone than at Spirit River. One of the most common forms in the *Gaudryina ST-876-A* zone at Spirit River, *Trochammina ST-910-A* has not been identified in the Pouce Coupe Area.

Haplophragmoides ST-902-A seems to be the only species restricted to the zone, but it is important to note that very few of the forms occurring either in this zone or in the underlying *Ammobaculites ST-930-A* zone are to be found above the Pouce Coupe sand. Among the prominent forms which do not appear above the top of the *Gaudryina ST-876-A* zone are: -

Ammobaculites ST-930-A
Gaudryina SR-1018-A
" ST-876-A
Trochammina ST-956-C
" S47-4-186-A*
Verneuilina SR-1009-A

THE AMMOBACULITES ST-747-A ZONE has its base coinciding with the top of the Pouce Coupe sand, but the placing of its exact top is rather doubtful. The writer is of the opinion that its upward limit can probably be placed at a footage of 150 above the top of the Pouce

* There is one isolated occurrence of this form at Pouce Coupe River, Locality G45-18, 15 feet above the Pouce Coupe sand.

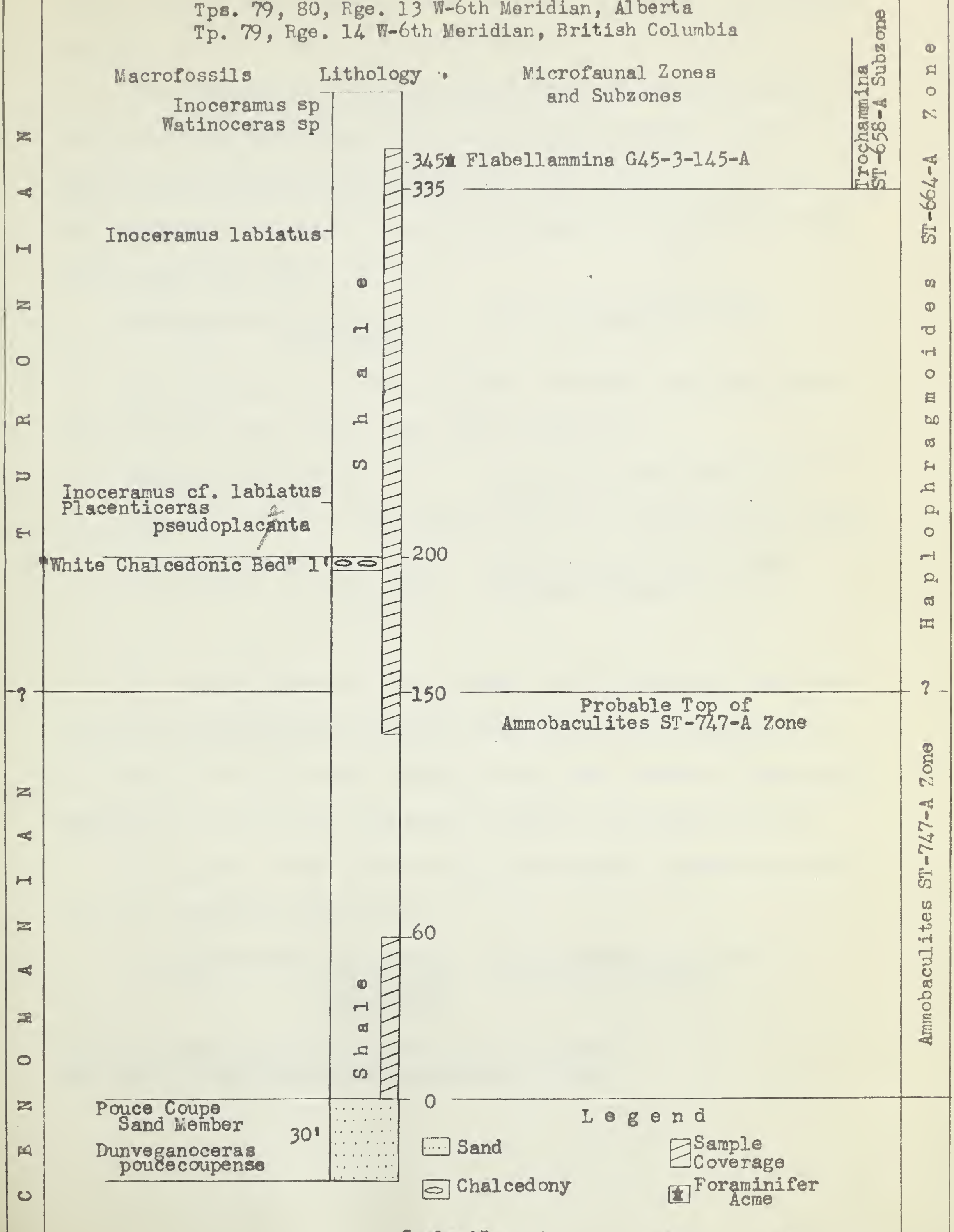
POUCE COUPE AREA

FIG. 6

CENTRAL PART OF KASKAPAU FORMATION

Surface Sections - Henderson Creek Localities G45-3, G45-4
" " - Pouce Coupe River Localities G45-6, G45-19

Tps. 79, 80, Rge. 13 W-6th Meridian, Alberta
Tp. 79, Rge. 14 W-6th Meridian, British Columbia


Macrofossils
Lithology
Microfaunal Zones and Subzones
Trochammina ST-658-A Subzone
Haplophragmoides ST-664-A Zone
TURONIAN
CENOMANIAN
Inoceramus sp
Watinoceras sp
345
Flabellammina G45-3-145-A
335
Inoceramus labiatus
Shale
Inoceramus cf. labiatus
Placenticeras pseudoplacenta
"White Chalcedonic Bed" 1'
200
?
150
?
Probable Top of Ammobaculites ST-747-A Zone
Ammobaculites ST-747-A Zone
60
Shale
0
Pouce Coupe Sand Member
30'
Dunveganoceras pouceccoupense
Legend
Sand
Chalcedony
Sample Coverage
Foraminifer Acme

Scale 1" = 50' J. H. Wall May, 1951.

Coupe, although three specimens were found 100 feet higher stratigraphically.

It is impossible to give an accurate list of the forms within this zone, as a break of 75 feet occurs in the sample coverage over the interval 60 to 135 feet above the Pouce Coupe sand. However, it is known that the following three species do not occur above the footage being taken as the top of the zone: -

Ammobaculites ST-747-A
" G45-19-0-A
Spiroplectammina ST-838-B

The following two species, although occurring very rarely above the top of the zone, attain their acmes within it: -

Ammobaculites ST-747-A
Haplophragmoides G45-4-55-A

The group of forms listed below occur both in and above the zone:-

Haplophragmoides G46-1-10-A
" G45-3-90-A
Flabellammina G45-3-145-A*
Tritaxia ST-664-B

THE HAPLOPHRAGMOIDES ST-664-A ZONE name is arbitrarily used here, although *Haplophragmoides ST-664-A* itself has not been recognized in the Henderson Creek section, because, among other evidence, *Trochammina ST-658-A* was found in the uppermost 15 feet of the sampled section.

The species found in this zone, which have not appeared previously in the underlying zones are: -

Haplophragmoides G45-3-80-A
" S47-35-6-A**
" G45-3-145-B
Flabellammina G45-3-50-A
Trochammina ST-658-A

* only found once at the extreme top of the zone.
** only two specimens found at Henderson Creek.

In addition, *Flabellammina G45-3-145-A* was only recorded once from below the zone, and reaches its acme near the top of the section, 145 feet above the "white chalcedonic bed" or about 345 feet above the Pouce Coupe sand.

Finally, as mentioned previously, the following three occur both in and below this zone: -

Haplophragmoides G46-1-10-A
" G45-3-90-A
Tritaxia ST-664-B

Kiskatinaw River Area

The lithological and microfaunal information gathered at the Kiskatinaw River locality is given on Figure 7. This section, the most westerly one studied, failed to yield many microfossils, and thus, it is difficult to correlate the microfauna here with the Pouce Coupe suites.

Lithology

The so-called "white chalcedonic bed", occurring 145 feet above the Pouce Coupe sand, consists of tuffaceous sandstone with white chalcedonic nodules.

The 50 feet of section sampled above this marker is made up chiefly of grey, silty shale, while the interval between it and the Pouce Coupe sand consists also of grey silty shale, but, with considerable interbedded sandstone and some ironstone bands.

The Pouce Coupe member, exposed at water level here is a fine-grained, clean, ripple-marked, sandstone.

Macropaleontology

Watinoceras sp. and Inoceramus labiatus var. latus Sowerby, Lower Turonian forms were picked up at about the same level as the "white chalcedonic bed". Exact footages are not available.

Micropaleontology

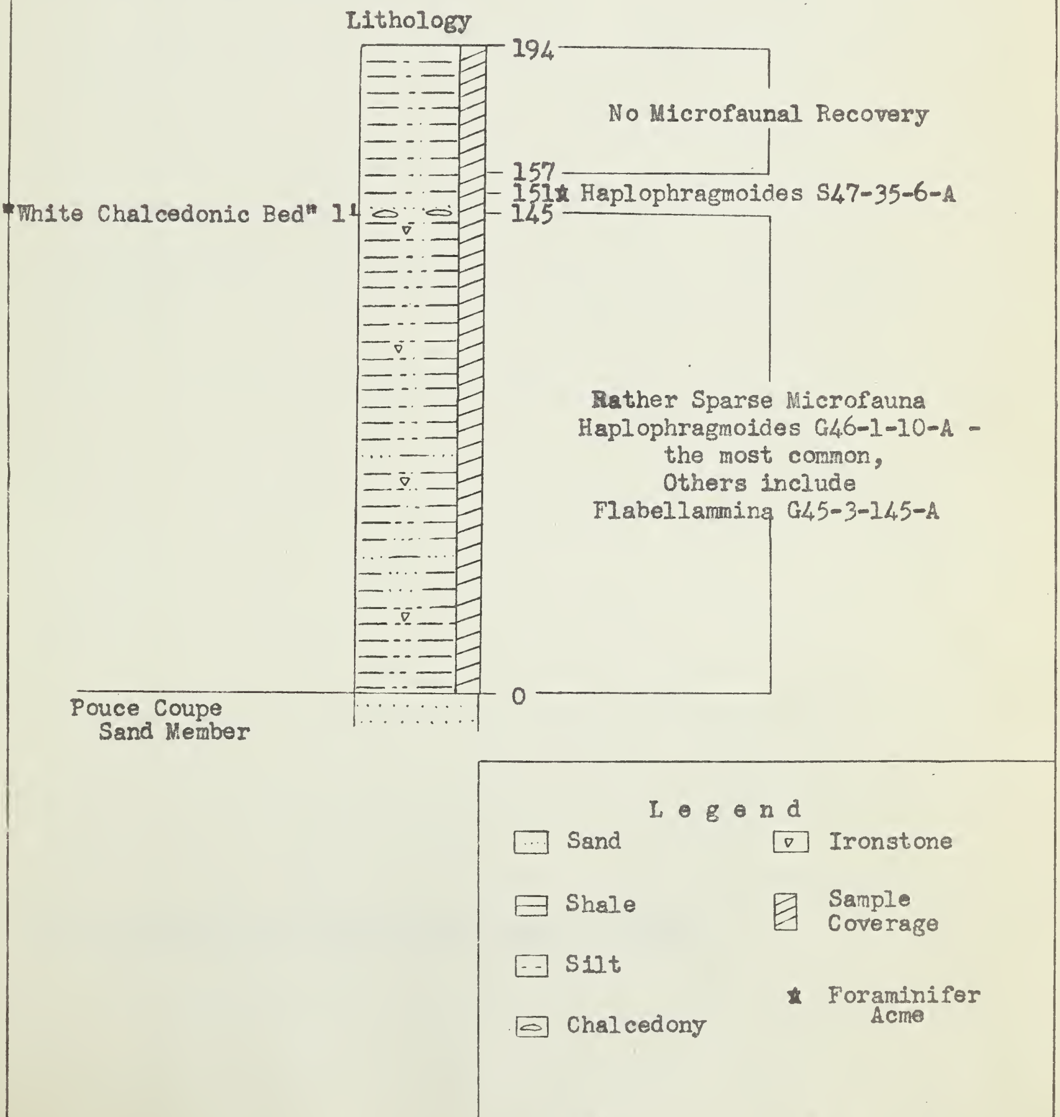
A rather sparse microfauna was recovered here, and it is not possible to zone the section microfaunally. However, elements of both the Ammobaculites ST-747-A and Haplophragmoides ST-664-A zones at Pouce Coupe are present here, but a dividing line cannot be drawn

KISKATINAW RIVER AREA FIG. 7

CENTRAL PART OF KASKAPAU FORMATION

Surface Section - Kiskatinaw River Localities S47-35, S47-36

Tp. 78, Rge. 17 W-6th Meridian, British Columbia


Lithology
194
No Microfaunal Recovery
157
151★ Haplophragmoides S47-35-6-A
"White Chalcedonic Bed" 1'
145
Rather Sparse Microfauna
Haplophragmoides G46-1-10-A -
the most common,
Others include
Flabellammina G45-3-145-A
0
Pouce Coupe
Sand Member
Legend
Sand
Shale
Silt
Chalcedony
Ironstone
Sample
Coverage
★ Foraminifer
Acme

Scale 1" = 50' J. H. Wall May, 1951

between the two. A list of the foraminifera recovered follows: -

Haplophragmoides	G46-1-10-A	Flabellammina	G45-3-50-A
"	S47-35-6-A	"	G45-3-145-A
"	G45-3-90-A	"	36-17-B of Stelck*
"	G45-3-80-A*	Textularia	G45-5-220-A*
"	G45-4-55-A*		
"	G45-3-145-B		

The acme of *Haplophragmoides S47-35-6-A* occurs a few feet above the "white chalcedonic bed".

. . .

---

* rare forms here occurring only once or twice.

Part II - CORRELATION OF THE CENTRAL AND LOWER PARTS OF THE KASKAPAU FORMATION

Cenomanian-Turonian Boundary

Warren and Stelck (1940, p. 144), place the Cenomanian-Turonian boundary at, or a few feet above the top of the Pouce Coupe sand, which contains the Dunveganoceras (Late Cenomanian) fauna. The writer found no foraminifera, other than those of the pelagic microfaunal zone, which could be identified with forms from outside of the area, and thus is dependent upon the occurrences of the various dated ammonite and pelecypods for age determination of microfaunal units. Accordingly, all of the foraminifera restricted to the lower part of the Kaskapau, that is, between the Pouce Coupe sand and the Dunvegan formation, are by direct calibration, Upper Cenomanian in age. The microfauna of the pelagic zone is known to be Lower Turonian in age.

The author suggests that the more refined boundary between the Cenomanian and Turonian should be drawn at the top of the Ammobaculites ST-747-A zone, that is, about 100 feet above the Pouce Coupe sand at Spirit River and 150 feet above it at Pouce Coupe. Although there is a pronounced change in microfaunal content in beds above and below the Pouce Coupe sand, that is, at the base of the Ammobaculites ST-747-A zone, it is not as significant as the break occurring at the top of the zone, because at the latter point, environmental changes are indicated - - - -

It would appear that the sediments from the top of the Dunvegan

to the top of the *Ammobaculites ST-747-A* zone, that is, 23 feet above the "Spirit River" sand, were deposited in a near-shore environment, whereas those of the overlying *Haplophragmoides ST-664-A* zone were deposited in deeper water, still relatively shallow, and within the neritic zone. The writer does not wish to convey the impression that environmental change should in itself, have any bearing on the placing of a time boundary, but in this case, the first Lower Turonian megafossils (*Inoceramus labiatus* var. *latus* fauna) appear 50 feet above this horizon of change at Spirit River, about 75 feet above at Pouce Coupe, and reflects the completed ecological shift to deeper water. The top of the *Ammobaculites ST-747-A* zone is the dividing line between the shallow water Cenomanian and deep water Turonian stages.

Local Correlation

Of the four sections discussed, the two at Spirit River and Pouce Coupe are, by far, the most important, since much more data is available concerning them. Consequently, the correlation between these localities is discussed first, after which the sections at Dunvegan and Kiskatinaw River are correlated with those at Spirit River and Pouce Coupe, respectively. Figure 8 shows the correlation across the area.

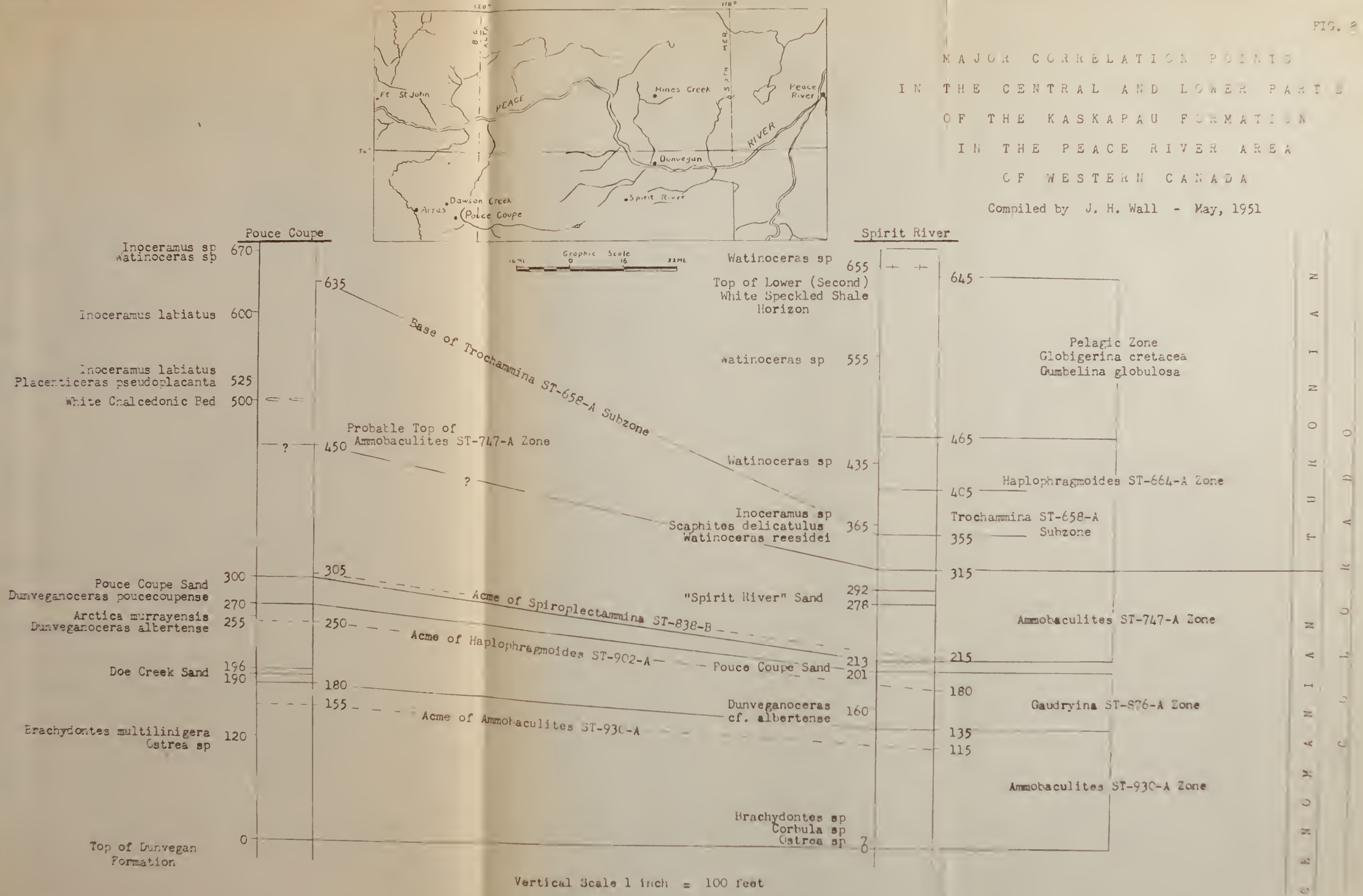
Correlation of Pouce Coupe and Spirit River Area Sections

The contribution made by each microfaunal zone to the general correlation is given, followed by a summary of the reasons for the correlation of the Pouce Coupe member: -

FIG. 2

MAJOR CORRELATION POINTS IN THE CENTRAL AND LOWER PARTS OF THE KASKAPAU FORMATION IN THE PEACE RIVER AREA OF WESTERN CANADA

Compiled by J. H. Wall - May, 1951



120°
118°
B.C. ALTA
5TH MER
Ft St John
PEACE
Hines Creek
Peace River
RIVER
56°
Dunvegan
Dawson Creek
Arras
Pouce Coupe
Spirit River
Graphic Scale
16 MI
0
16
32 MI
Pouce Coupe
Inoceramus sp
Watinoceras sp
670
635
Inoceramus labiatus
600
Inoceramus labiatus
Placenticeras pseudoplacanta
525
White Chalcedonic Bed
500
Base of Trochammina ST-658-A Subzone
?
450
Probable Top of Ammobaculites ST-747-A Zone
?
Pouce Coupe Sand
Dunveganoceras poucecoupense
300
305
270
Arctica murrayensis
Dunveganoceras albertense
255
250
Acme of Spiroplectammina ST-838-B
Acme of Haplophragmoides ST-902-A
Pouce Coupe Sand
Doe Creek Sand
196
190
180
155
Acme of Ammobaculites ST-930-A
Brachydontes multilinigera
Ostrea sp
120
Top of Dunvegan Formation
0
Spirit River
Watinoceras sp
655
645
Top of Lower (Second) White Speckled Shale Horizon
Watinoceras sp
555
Pelagic Zone
Globigerina cretacea
Gumbelina globulosa
465
Watinoceras sp
435
405
Haplophragmoides ST-664-A Zone
Inoceramus sp
Scaphites delicatulus
Watinoceras reesidei
365
355
Trochammina ST-658-A Subzone
315
"Spirit River" Sand
292
278
Ammobaculites ST-747-A Zone
213
215
201
180
Dunveganoceras cf. albertense
160
Gaudryina ST-876-A Zone
135
115
Ammobaculites ST-930-A Zone
Brachydontes sp
Corbula sp
Ostrea sp
0
TURONIAN
CENOMANIAN
COLORADO
Vertical Scale 1 inch = 100 feet

THE AMMOBACULITES ST-930-A ZONE has the following forms either restricted to it or their acmes within it and not commonly found above it: -

Pouce Coupe	Spirit River
Ammobaculites ST-930-A - - - - - - - -	Ammobaculites ST-930-A
" G45-5-110-A	Ammomarginulina ST-956-A
Ammomarginulina ST-956-B - - - - - - -	" ST-956-B
Flabellammina SR-1013-A - - - - - - - -	Flabellammina SR-1013-A
" ST-937-A - - - - - - -	" ST-937-A
" G45-5-105-A	" SR-1011-A
" G45-5-105-B	" C47-9-95-A
" G45-5-115-A	Proteonina SR-1034-A
Trochammina ST-956-C - - - - - - - -	Trochammina ST-956-C
" ST-892-A - - - - - - - -	" ST-892-A
" S47-4-186-A - - - - - - -	" S47-4-186-A
Haplophragmoides G45-5-85-A - - - - -	Haplophragmoides G45-5-85-A
Verneuilina G45-5-110-C	" ST-958-A

It will be seen that 8 of the above 13 species are common to both areas. In addition, both *Ammobaculites G45-5-110-A* and *Flabellammina G45-5-115-A*, from the Pouce Coupe Area, are probably present at Spirit River, but outside of one or two isolated occurrences, they cannot be positively identified. *Flabellammina G45-5-105-A* and *F. G45-5-105-B* are not found at Spirit River either in this zone or in any overlying zone. Finally, *Verneuilina G45-5-110-C* and *Haplophragmoides ST-958-A* occur in both areas in the zone, but with the former ranging somewhat higher stratigraphically at Spirit River.

Conclusion: - On the evidence presented above, the writer concludes that the lower 180 feet or possibly the lower 160 feet at Pouce Coupe can be correlated with the lower 135 feet of the Kaskapau at Spirit River.

THE GAUDRYINA ST-876-A ZONE has the following forms either confined to it or their acmes within it and not commonly found outside: -

Pouce Coupe	Spirit River
Haplophragmoides ST-902-A	Haplophragmoides ST-902-A
	Trochammina ST-910-A

In addition, the following group of prominent species, although occurring more or less commonly in the underlying Ammobaculites ST-930-A zone in both areas, is not found above the top of the Gaudryina ST-876-A zone or the Pouce Coupe sand: -

Ammobaculites ST-930-A
Gaudryina SR-1018-A
" ST-876-A

Trochammina ST-956-C
Verneuilina SR-1009-A

Conclusion: - From the above, it is concluded that the 90 feet of section from the top of the Ammobaculites ST-930-A zone to the base of the Pouce Coupe sand in the Pouce Coupe Area, correlates with the corresponding 66 foot interval at Spirit River and that the bed of sand immediately overlying the top of the zone at the latter locality, 201 to 213 feet above the base of the Kaskapau (842 - 854 feet in section), is the correlative of the Pouce Coupe member at its type locality.

THE AMMOBACULITES ST-747-A ZONE has the following forms either restricted to it or their acmes within it and not commonly found elsewhere: -

Pouce Coupe	Spirit River
Ammobaculites ST-747-A	Ammobaculites ST-747-A
" ST-745-A	" ST-745-A
" G45-19-0-A	" G45-19-0-A
Haplophragmoides ST-740-A	Haplophragmoides ST-740-A

- (continued) -

(continued)

Pouce Coupe	Spirit River
Haplophragmoides G45-4-55-A	Haplophragmoides ST-838-A
Spiroplectammina ST-838-B - - - - - -	Spiroplectammina ST-838-B
	Dorothia ST-830-A
	" ST-834-A
	Gumbelitria ST-782-A
	Textularia ST-747-A
	Trochammina ST-812-A

It will be seen that nearly half of the above species are common to both areas, and it is desirous to point out that these five forms occur more abundantly than the group not in common. In this latter connection, it should be mentioned that Textularia ST-747-A is a very small, pyritized, rare form, not found outside of Spirit River, and that Gumbelitria ST-782-A, a rather rare form also, would probably not be recovered in normal sampling of surface outcrops.

It has been stated previously that the placing of the top of this zone is doubtful in the Pouce Coupe Area, because three specimens of Ammobaculites ST-747-A were found in a sample, 100 feet higher stratigraphically than the horizon, which is presently considered the top (150 feet above the Pouce Coupe sand). However, these occurrences are entirely isolated from the main group of specimens, with none being found in the intervening 100 feet. Furthermore, only one specimen of Flabellammina G45-3-50-A was found at Spirit River, and this at 10 feet above the top of the Ammobaculites ST-747-A zone (see Appendix). At Henderson Creek, this species does not appear to occur any lower than 10 feet above the same horizon. Thus, these occurrences of Flabellammina G45-3-50-A tend to indicate that the

level taken for the top of the Ammobaculites ST-747-A zone at Pouce Coupe is equivalent to the one at Spirit River.

Conclusion: - From the above evidence, the correlation of the 150 feet of sediments immediately above the Pouce Coupe sand in the Pouce Coupe Area with the 102 feet of beds above the Pouce Coupe equivalent at Spirit River is indicated. The occurrence of identical forms in both the Pouce Coupe and Spirit River Areas in beds above the Pouce Coupe sand serves to establish correlation of this member.

THE HAPLOPHRAGMOIDES ST-664-A ZONE seems to have its associated sediments thinning out more rapidly in the direction of Spirit River, than do the underlying beds, where they are represented by relatively small fractions of their thicknesses in the former area. The arguments for this are: -

(1) In the Pouce Coupe Area, the first specimens of Trochammina ST-658-A are not encountered until one moves upward in the section for 335 feet above the Pouce Coupe sand, whereas in the Spirit River Area, the base of the Trochammina ST-658-A subzone occurs at a footage of 138 above the Pouce Coupe equivalent.

(2) In the Pouce Coupe Area, Haplophragmoides G46-1-10-A occurs more or less commonly in the beds from the Pouce Coupe sand to the top of the section, whereas at Spirit River, this form does not appear at levels higher than about 115 feet above the Pouce Coupe equivalent.

(3) In the Pouce Coupe Area, Flabellammina G45-3-50-A occurs

more or less commonly in the beds from 160 feet above the Pouce Coupe sand to the top of the section, but at Spirit River, the only specimen found was at a footage of about 110 above the Pouce Coupe equivalent.

(4) In the Pouce Coupe Area, Flabellammina G45-3-145-A is one of the most common forms, occurring above the top of the Ammobaculites ST-747-A zone, but at Spirit River this species is missing completely.

(5) Haplophragmoides ST-664-A itself has not been recognized in the Pouce Coupe Area, although it occurs abundantly at Spirit River. If it is to be found in the former area, one would expect it above the top of the sampled section.

THE PELAGIC MICROFAUNAL ZONE has not been observed in the Pouce Coupe Area, nor has its accompanying lithologic marker, the Lower (Second) White Speckled Shale. The upper central and upper parts of the Kaskapau are unfortunately almost entirely concealed in the area, and until such time as a core hole is drilled in an appropriate location, our knowledge regarding these horizons in the western part of the report area is restricted.

The Pouce Coupe Sand

The arguments for correlation of the Pouce Coupe member from Pouce Coupe to Spirit River are as follows:

(1) There is a very noticeable difference of microfaunal content of the beds above and below the sand in both areas, shown in discussion of the foraminifera in the principal zones.

(2) The acmes of two foraminiferal species, Spiroplectammina ST-838-B and Haplophragmoides ST-902-A occur respectively directly above, and about 20 feet below, the Pouce Coupe Sand in both areas.

(3) The correlation of the other prospective sand in the Spirit River Area, that is, the so-called "Spirit River" sand, with the Pouce Coupe member at its type locality seems extremely unlikely because, (a) there is no break in the microfaunal sequence across the former, and (b) one would have to account for a slight thickening, or at best, no change in thickness of the "lower" part of the Kaskapau across the area, although there is a definite trend of thinning from west to east in all of the other lithological units.

Correlation of Spirit River and Dunvegan Area Sections

THE AMMOBACULITES ST-930-A ZONE is not completely known at Dunvegan because of inadequate sample coverage. Thus, there is little point in listing the forms restricted to this zone at both localities, since the greater number found at Spirit River would tend to distort the correlation picture. However, the following four species, common to both areas, are either restricted to this zone or attain their maximum development in it and are rarely found above: -

Ammobaculites ST-930-A
Trochammina ST-956-C

Flabellammina C47-9-95-A
" SR-1013-A*

* found only once at Dunvegan.

In addition, one or two specimens of *Flabellammina G45-5-105-B* were found in the zone at Dunvegan. This form, although not recovered at Spirit River, is confined to this zone in the Pouce Coupe Area.

Conclusion: - The lower 110 feet of the Kaskapau at Dunvegan can probably be correlated with the lower 135 feet at Spirit River.

THE GAUDRYINA ST-876-A ZONE is only partially known at Dunvegan because of lack of sample coverage, but the following characteristic forms were recorded at both Dunvegan and Spirit River: -

Gaudryina SR-1018-A
" ST-876-A
Haplophragmoides ST-902-A
Trochammina ST-910-A
Verneuilina SR-1009-A

THE AMMOBACULITES ST-747-A ZONE is also only partially known at Dunvegan. There is a possibility that its base might be taken to correspond to the top of the sandstone bed, 189 feet above the base of the Kaskapau, but its placement here appears unlikely for a variety of reasons, mentioned below. In any case, the following three typical species found at Dunvegan are present also at Spirit River and Pouce Coupe: -

Ammobaculites ST-747-A
" G45-19-0-A
Haplophragmoides ST-740-A

The "Spirit River" sand at the Dunvegan Locality

The sandstone bed, 180 to 189 feet above the base of the Kaskapau at Dunvegan is correlated with difficulty, because of the gaps in the sample coverage curbing the value of the microfaunal evidence.

However, it can be correlated with the "Spirit River" sand rather than the Pouce Coupe sand at Spirit River because of the following reasons:-

(1) If the sand were the Pouce Coupe member at Dunvegan, a thickness of at least 79 feet would have to be postulated for the Gaudryina ST-876-A microfaunal zone, which although not unreasonable, appears unlikely because it is only 78 feet thick at Spirit River. Regionally, this zone would be expected to thin considerably in a north-east direction.

(2) A concentration of specimens of Haplophragmoides ST-902-A, 20 feet below the top of the sampled section at Dunvegan, indicates that the possible top of the Gaudryina ST-876-A zone and, thus, the position of the Pouce Coupe equivalent, might be expected to occur at about the top of the sampled section. The possibility exists that the Pouce Coupe may have pinched out altogether at Dunvegan.

(3) The lack of any specimens of Spiroplectammina ST-838-B above the sandstone bed at Dunvegan indicates correlation with the "Spirit River" sand, because this form occurs characteristically directly above the Pouce Coupe sand at Spirit River and Pouce Coupe.

(4) The sparse microfauna recovered from the 16 feet sampled directly below the sandstone bed, although it does not contain any recognizable specimens of Ammobaculites ST-747-A or Ammobaculites G45-19-0-A (species occurring characteristically in the interval between the Pouce Coupe and "Spirit River" sands at Spirit River) also cannot be used to support a Pouce Coupe member correlation for the above sandstone. This microfauna, with its'undiagnostic

Haplophragmoides and lack of recognizable species of Ammobaculites, does not appear unlike the fauna recovered from the beds directly below the "Spirit River" sand at Spirit River, which is rather barren, and along with similar forms of Haplophragmoides, contains only a very few specimens of Ammobaculites ST-747-A and Ammobaculites G45-19-0-A.

Correlation of Pouce Coupe - Kiskatinaw River Area Sections

Because of poor microfossil recovery at the Kiskatinaw River locality, the writer was unable to establish a definite microfaunal zoning, and thus, could not make any detailed correlation across to the Pouce Coupe locality. However, the presence of the "white chalcedonic bed" and the Pouce Coupe sand at this locality, assures its general correlation with the Pouce Coupe section. It appears that the interval from the "white chalcedonic bed" to the Pouce Coupe sand is about 50 feet thinner here than at Pouce Coupe.

Regional Correlation

In this report, the writer is primarily concerned with the correlation role of the microfaunal suites, but during the following discussion, mention is also made of the various megafaunal zones used by others in working out the regional correlation.

With very few exceptions, the foraminifera of the pelagic microfaunal zone, are the only forms which can be used in making correlation from the Peace River to the southern areas. The Cenomanian foraminifera of the lower part of the Kaskapau constitute a definitely localized fauna, of practically no value in determining correlation with outside areas.

Central and Southern Alberta Foothills

The central and lower parts of the Kaskapau formation in the Peace River Area appear correlative with most of the Blackstone formation of the Foothills. No microfaunal work has been done on the Blackstone beds, but megafossil evidence outlined by Webb and Hertlein (1934), shows lower Turonian species Inoceramus labiatus Schlotheim and Collignoniceras woolgari (Mantell), the former occurring abundantly in the central and lower Blackstone beds, while one specimen of the late Cenomanian Dunveganoceras albertense (Warren) was found in the lower or "Barren Zone" of the Blackstone.

Central Alberta Plains (Edmonton Area)

The Lower Turonian pelagic microfauna exists in both the Edmonton and Peace River Areas, having been found in beds from the Second White Speckled Shale zone of the Colorado Group in the Anglo-Canadian, Home,

C. & E. Wabamun Lake #1 Well[*], (about 45 miles west of Edmonton, Alberta) and the Lower Speckled Shale zone of the Kaskapau in the Peace River Area. Most workers had previously equated the Lower Speckled Shale zone in the northern area with the Second White Speckled Shale zone of the southern area, so the presence of an identical microfauna merely confirms this hypothesis.

At Spirit River, the pelagic microfauna is found directly at the top of the speckled shale and covers 180 feet of section. At the Wabamun Lake well, where the fauna is observed 100 feet below the second speckled shale, its exact range is not known since no core samples were taken for the first 50 feet of the zone. The microfauna, in both areas, consists of the following three species: -

Globigerina cretacea d'Orbigny
Gumbelina globulosa (Ehrenberg)
Gumbelitria cretacea Cushman

East Central Alberta Plains (Vermilion Area)

Nauss (1945, p. 1617) has reported the characteristic occurrences of Globigerina cretacea and Gumbelina globulosa in the central part of the Lloydminster shale of the Saskatchewan-Alberta border area. This horizon would correspond to the second or lower white speckled shale zone of the Colorado and Kaskapau formations of the Edmonton and Peace River Areas, respectively. As supporting evidence, Nauss (ibid.) reported the presence of Inoceramus labiatus, 112 miles

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[*] Lsd.5 - Sec.5 - Tp.51 - Rge.4 - W 5th Meridian.

north-east of Lloydminster, at the south end of Green Lake, Saskatchewan, in association with abundant Globigerina.

Southern Alberta and Southern Saskatchewan

The pelagic microfauna has not been recorded in any published reports from wells in the southern Alberta and Saskatchewan region, but its presence may be assumed since the Second White Specks zone has been recognized in the Alberta Shale of the general area. Webb (1934, p. 1410), in a well near Taber, Alberta, observed elements of the Inoceramus labiatus zone with Inoceramus cf. labiatus and Collignoniceras cf. woolgari identified from beds just above the top of the Blackleaf Sandy member of the Colorado, which would fall within the Second White Speckled Shale zone.

Southern Manitoba

From the Favel formation of Manitoba, Wickenden (1945, p. 33) reports the occurrence of Gumbelina globulosa, Gumbelitria cretacea, and Globigerina cretacea. In addition, Inoceramus labiatus was recorded from the Keld or lower member of this formation. The Favel, 170 feet maximum thickness, is thus considered the correlative of the Lower or Second White Speckled Shale horizon of the Kaskapau.

Wickenden states (ibid), "on the basis of fossils, the Favel can be correlated with the Greenhorn limestone and Carlyle shale in the United States and part of the Lower Alberta formation in the southern Foothills, the Blackstone formation in the northern Foothills of Alberta, and the Kaskapau of the northern Alberta Plains". Undoubtedly, when referring to "fossils", Wickenden had in mind the occurrence

of the widespread index Inoceramus labiatus, and not any microfossils, when making the Favel-Blackstone-Kaskapau correlation. The tracing of the pelagic microfauna from Manitoba to Peace River shows that Wickenden's interpretation is entirely correct.

Southern Montana

Young (1951) has recently reported the occurrence of Globigerina cretacea and Gumbelina globulosa from the "Vascoceras beds" of the Frontier formation of southern Montana. As these "Vascoceras beds" are described as blue calcareous shale, carrying Inoceramus labiatus, it appears that they represent the approximate equivalent of the Second or Lower White Speckled Shale horizon of the Kaskapau in the Peace River Area.

Rocky Mountain Region of the United States

The Lower or Second White Speckled Shale zone of the Kaskapau seems to occupy a stratigraphic position equivalent to the Greenhorn limestone of Nebraska, South Dakota, and northern Colorado, with Inoceramus labiatus occurring throughout the region in this horizon. In southern Colorado, Wyoming, and New Mexico, the Inoceramus labiatus fauna occurs in the lower part of the Mancos shale, which would indicate correlation of that part of the Mancos with the Lower Speckled Shale horizon of the Kaskapau.

Texas

Nauss (1945, p. 1617) states that the zone of pelagic foraminifera, characteristic of the central part of the Lloydminster shale of the Vermilion Area, "is widespread and can be followed through the Mid-Continent region of the United States into Texas, where it is represented

by the Eagle Ford formation". The occurrence of the pelagic microfauna in the Kaskapau merely serves to extend this correlation into the Peace River Area.

In Volume 1, Part 2 of "The Geology of Texas" (1933, p. 438), the following forms were included in a list of the Eagle Ford foraminifera prepared by Helen Jeanne Plummer: -

Globigerina cretacea d'Orbigny
Gumbelina globulosa (Ehrenberg)
Haplophragmoides aff. calcula Cushman and Waters
Trochammina diagonis (Carsey)
Ventilabrella eggeri Cushman

Although none of the above five species were considered especially characteristic of the Eagle Ford, Globigerina cretacea and Gumbelina globulosa occur in the Kaskapau, while Haplophragmoides ST-740-A and Trochammina ST-658-A of the late Cenomanian and early Turonian of the Kaskapau are closely related to Haplophragmoides calcula and Trochammina diagonis. Ventilabrella eggeri, although not found in the Kaskapau, has been reported by Wickenden from the correlative Favel of Manitoba.

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Part III - THE FORAMINIFERAL FAUNAS OF THE CENTRAL AND LOWER PARTS OF THE KASKAPAU FORMATION

Nomenclature

Fifty-five "species" of foraminifera are described in the following section, with their ranges and comparisons added. Of the fifty-five "species", three (the pelagic species) have been described in literature, while Stelck (1950) has described thirteen in an unpublished work. The remaining thirty-nine forms have not, to the writer's knowledge, been described in any published or unpublished works.

Some of the forms described are probably of no higher standing than varietal rank, and it would not be technically correct to speak of "fifty-five species". However, there do not appear to be more than seven of these varietal forms, and the remainder of the forms seem entitled to specific rank. An attempt was made to speciate the faunas by following the forms through the sequence of beds to detect any possible evolutionary changes.

An effort was made to describe all of the commonly occurring forms and rarer forms also, if they turned out to be of any value stratigraphically. Although many of the same localities were examined by both Stelck and the writer, the latter saw little benefit to be derived from describing species, other than those that contributed directly to correlation within the area or are related to outside species. Stelck's thesis endeavored to establish a complete

microfaunal sequence through the Albian and Cenomanian beds, dating the faunas from their association with ammonite and pelecypod zones of known exact geologic age. In the course of Stelck's research, nearly all of the forms recovered in the outcrop samples were described, including some very rare forms, in the hope that if any similarities whatever to outside species existed, such similarities could thus be recognized and evaluated. The writer, on the other hand, has been primarily interested in effecting close correlation within a relatively small area, and most of the species described were chosen because of suitability for this purpose.

Because of normal delay in publication, each species is designated by a combination of symbols and numerals, rather than by an official zoological name. In nearly every case, the specific designation is a key to the locality and level of the holotype. For example, the holotype of Ammobaculites ST-930-A comes from the Spirit River Structure Test hole at a depth of 930 feet, while the holotype of Verneuilina G45-5-110-C was chosen from Locality G45-5 at a footage of 110 below the base of the Pouce Coupe sand. A final letter is always given to the name in case there are, or might be at some later date, other holotypes, either for other species of the same genus or different genera, picked from the same bed. The descriptions are arranged in alphabetical sequence, with the older species of each genus described first.

The table in pocket illustrates the relative abundance of the families, sub-families, and genera, using the Galloway (1933)

classification, in the three broad faunal units, as outlined below. The percentage figures on the chart were determined by a complete count of individual specimens (6,840) in the Spirit River section and reveal in part the ecological groups.

Ecology

There appear to be three separate faunas represented in the interval from the base of the Kaskapau to the Lower White Speckled Shale horizon at Spirit River, which are: -

(1) The microfauna of Upper Cenomanian age extending from the base of the Kaskapau to the base of the *Haplophragmoides* ST-664-A zone, that is 23 feet above the "Spirit River" sand. This fauna includes all species of the *Ammobaculites* ST-930-A, *Gaudryina* ST-876-A, and *Ammobaculites* ST-747-A zones.

(2) The microfauna of Lower Turonian age, found in the *Haplophragmoides* ST-664-A zone.

(3) The microfauna of Lower Turonian age, contained within the Pelagic Microfaunal zone.

Upper Cenomanian Microfauna

Of the three faunas, the Upper Cenomanian one has the largest number of genera, but it will be seen that almost all of the forms (94%) are included in two families, the *Trochamminidae* and *Ataxophragmiidae*, with the former in turn comprising a great bulk (85%) of the total. The three most commonly occurring genera with percentages of total in parentheses are *Haplophragmoides* (40%), *Trochammina* (20%), and *Ammobaculites* (18%).

This fauna is a local or provincial one. Practically none of the forms have been recognized from outside areas, with the exception of *Haplophragmoides ST-740-A*, which is similar to *Haplophragmoides calcula* from the Upper Cretaceous of Texas. The dwarfed nature of some of the species of this fauna would lead one to believe that it is provincial. The following species are definitely tiny forms: -

Haplophragmoides SR-1018-B
" SR-1011-B
" ST-958-A
Textularia ST-747-A
Trochammina S47-4-186-A
Verneuilina G45-5-110-C

In addition, most of the remainder of the species are considerably smaller than the Upper Cretaceous forms of the Gulf Coast region. Many of the species described in the following section are rather grotesque forms, which resemble nothing in the literature.

The *environment* of the above fauna is regarded as being very near shore, probably cold brackish water for the following reasons: -

(1) The abundance of coarsely arenaceous forms, such as *Haplophragmoides ST-740-A*, *Ammobaculites ST-747-A* and *Ammobaculites G45-19-0-A*, is generally indicative of very shallow water.

(2) The occurrence of oysters in the accompanying megafauna points to a shore line phase.

(3) The sediments from the top of the Dunvegan to the top of the *Ammobaculites ST-747-A* zone, including the Pouce Coupe and "Spirit River" sands, seem to constitute one lithologic unit of shale with considerable interbedded sand, which would appear to have been deposited in shallow water.

(4) The replacement by iron sulfide (pyritization) of the

original wall material of many specimens in the fauna seems to indicate a rather toxic condition, possibly such as one would encounter in a brackish water, lagoonal (?) type of environment.

(5) There are no exclusively deep water forms in the fauna. Some of the genera, such as Dorothia, have been reported only from shallow water deposits in outside areas, while nearly all of the others are definitely associated with a shallow water habitat.

(6) The almost total absence of any calcareous forms such as one would expect to find in a warm water environment, seems to indicate a cool or temperate water habitat, not unlike those along our present day Atlantic shoreline.

Lower Turonian Haplophragmoides ST-664-A Microfauna

Only four genera are represented in this Lower Turonian fauna, Haplophragmoides (52%), Trochammina (22%), Gumbelitria (17%), and Tritaxia (9%).

The environment of the fauna appears neritic, but relatively shallow and cool, with depth of water probably in the neighborhood of 100 to 300 feet, but perhaps as deep as 600 feet, a depth equivalent to the seaward edge of our present day continental shelf. The reasons for this interpretation are: -

(1) The species of Haplophragmoides and Trochammina, Haplophragmoides ST-664-A and Trochammina ST-658-A, characteristic of the fauna, are more finely arenaceous than are the species of these genera, typical of the fauna of the underlying Ammobaculites ST-747-A zone. The preponderance of finely arenaceous forms seems to indicate a somewhat deeper water phase than the one inhabited by coarsely

arenaceous forms.

(2) The temporary disappearance of such normally shallow water forms as Ammobaculites, Dorothia, Gaudryina, and others, at the end of the Cenomanian (writer's interpretation), would indicate a deeper water depositional environment for the later sediments.

(3) Tritaxia, a finely arenaceous genus, occurring much more commonly in this fauna than elsewhere, has not been reported (Galloway 1933, p. 218) from Recent oceans in water any shallower than 155 fathoms.

(4) The Inocerami of the accompanying megafauna are relatively thin-shelled, a feature of deeper water pelecypods.

(5) The comparative dearth of calcareous forms is indicative of a cool water habitat for this fauna also as for the Upper Cenomanian fauna.

Lower Turonian Pelagic Microfauna

The three genera which comprise over 99% of this Pelagic fauna are Gumbelitria (44%), Globigerina (32%), and Gumbelina (23%). The only other genus found was Haplophragmoides, specimens of which constitute less than 1% of the overall total.

Environment: - It is difficult to interpret the environment of such a pelagic assemblage of foraminifera. Globigerina occurs abundantly in the bathyal zone (600 to 6000 feet) of our Recent oceans, but since this genus is pelagic, it would not be unreasonable to expect a fair number of specimens in the neritic zone (100 to 600 feet) or straddling the neritic and bathyal zones. The presence of this pelagic

microfauna is probably indicative of a deeper part of the neritic environment, than is the fauna of the underlying Haplophragmoides ST-664-A zone. It would be rather difficult to account for the presence of a continental slope or bathyal zone in the Peace River Area during Upper Cretaceous time.

The occurrence of pelagic forms to the exclusion of nearly all other groups might be interpreted as an indication of unfavorable conditions for benthonic microfaunas within the neritic environment.

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FORMAL DESCRIPTIONS

Order Foraminifera

Genus AMMOBACULITES Cushman, 1910

Ammobaculites ST-930-A

Plate I, Fig. 1, 2, 3.

Test somewhat compressed, subcylindrical in cross-section, early part not tightly coiled with five chambers visible in ultimate whorl, later portion in straight series of three to four chambers, occasionally five; sutures distinct, depressed, at right angles to long axis or slightly oblique; wall finely arenaceous, grains averaging .015 mm., a few up to .03 mm., with a considerable amount of cement, giving a smooth exterior finish; aperture, terminal, at end of short collar, simple, appearing elliptical in compressed specimens.

Length of holotype (Fig. 1) .44 mm.; diameter of coiled portion .17 mm.; length of ultimate chamber .15 mm.; width of ultimate chamber .14 mm.

Length of paratype (Fig. 2) .44 mm.

Length of paratype (Fig. 3) .76 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 930 feet, 125 feet above the projected base of the Kaskapau formation.

Paratype (Fig. 2) locality: - Imperial Oil Limited Surface Division Locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian,

Doe Creek, Alberta, at a footage of 165 below the base of the Pouce Coupe sand.

Paratype (Fig. 3) locality: - same as for holotype, at a depth of 937.5 feet.

Holotype and Paratypes: - University of Alberta Paleontological Type Collection.

Range: - This species is restricted to the basal portion of the Kaskapau at all localities, rarely occurring above the top of the Ammobaculites ST-930-A zone, and unrecorded to date above the top of the Gaudryina ST-876-A zone, that is, the top of the Pouce Coupe sand. Maximum development occurs in the Spirit River section at a footage of 115 above the base of the Kaskapau; at the Dunvegan locality of C47-9 at a footage of 95 above the base; at the Doe Creek localities of G45-5 and S47-4 at a footage of approximately 155 above the base of the Kaskapau.

Comparison: - This species is similar to Ammobaculites tyrrelli Nauss, in having the same type of wall structure, transverse sutures, and an apertural accentuation. However, A. tyrrelli is a much more robust form than this species, and differs also in having a more involute coiled portion. Furthermore, the chamber dimensions in the two species are different, with the length and width of the chambers in the uniserial portion of A. ST-930-A being approximately equal, whereas in A tyrrelli, the length is much shorter than the width.

Ammobaculites G45-5-110-A

Plate I, Fig. 4.

Test roughly square in outline, compressed, consisting only of a closely coiled early portion with seven chambers visible in ultimate whorl; wall coarsely arenaceous, with sharply angular grains of about .04 mm. in maximum diameter, very little cement present giving mosaic appearance to the test, and a transparent glaze to the exterior; sutures slightly curved, slightly raised, thickened; aperture simple, near the peripheral margin on the ultimate face.

Maximum diameter of holotype .42 mm., thickness .15 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, Doe Creek, Alberta, at a footage of 110 below the base of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - Most of the specimens of this rather rare species are found at the Doe Creek localities G45-5 and S47-4, where maximum development occurs at a footage of 155 above the base of the Kaskapau, with the species rarely being observed above this level.

Only one positive identification was made in the Spirit River Structure Test hole at a footage of 94 above the base of the Kaskapau. Excessive pyritization of many lower Kaskapau forms in the Spirit River Area renders any further identifications of this species questionable.

Comparison: - This species is similar to Haplophragmoides rugosa Cushman and Waters from the Upper Cretaceous Navarro formation of Texas

in having an identical wall structure, that is one composed of neatly fitting angular grains. However, the Canadian species is much compressed, thinner, and is readily distinguished by its broad sutures. The position of the aperture retains this species in Ammobaculites.

Ammobaculites G45-19-0-A

Plate II, Fig. 12,13,14.

Test fairly robust, umbilicate, consisting of a coiled portion only, of five to six chambers, ultimate one roughly pentagonal in outline; sutures depressed, usually obscure, but readily visible in partially pyritized forms, and in some surface specimens; wall coarsely arenaceous, grains up to .075 mm., in figured specimens, larger in others, held together by a relatively small amount of cementing material; aperture terminal, simple, at about the apex of the ultimate chamber.

Length of holotype (Fig. 12) .33 mm.; length of ultimate chamber .17 mm.; width of ultimate chamber .22 mm.

Length of paratype (Fig. 13) .45 mm.; length of ultimate chamber .21 mm.; width of ultimate chamber .25 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-19 in Lsd. 8, Sec. 4, Tp. 80, Rge. 13- W 6th Meridian, on the east bank of the Pouce Coupe River, Alberta, in a sample taken from 0 to 5 feet above the Pouce Coupe sand.

Paratype (Fig. 13) locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 816 feet, 26 feet above the top of the Pouce Coupe sand equivalent.

Paratype (Fig. 14) locality: - as above, at a depth of 747.5 feet, 15.5 feet above the top of the "Spirit River" sand.

Holotype and Paratypes: - University of Alberta Paleontological Type Collection.

Range: - This species was found to occur commonly in the _Ammobaculites ST-747-A_ zone at Spirit River, not above it, and only rarely below the Pouce Coupe sand equivalent, in the top beds of the underlying _Gaudryina ST-876-A_ zone. At the Dunvegan locality of S47-27, the species was found in a sample taken 2 feet above the top of the "Spirit River" sand equivalent, while at the Pouce Coupe River locality of G45-19, it was not observed any higher stratigraphically than the 0 to 5 feet interval above the Pouce Coupe sand.

Comparison: - This species is the same as _Ammobaculites 27-2-B_ of Stelck from the Dunvegan locality of S47-27 at a point 2 feet above the "Spirit River" sand equivalent. It is similar to _Haplophragmoides ST-740-A_, in having identical wall structure and sutures, but the terminal position of the aperture in _Ammobaculites G45-19-0-A_ and the general appearance of its ultimate chamber, which seems to indicate that an uncoiled uniserial portion is about to develop, serve to distinguish between these two forms. It appears likely that _Ammobaculites G45-19-0-A_ has descended from _Haplophragmoides ST-740-A_.

Ammobaculites ST-747-A

Plate II, Fig. 20, 21.

Test robust, cylindrical in cross-section, often found as a pyritized or partially pyritized replacement, early portion tightly coiled, comprising one-quarter to one-third of overall length of test, with generally three chambers, occasionally four, visible; later portion of two to three chambers, of approximately equal size, in straight uniserial arrangement; sutures distinct, depressed, at right angles to long axis of test; wall arenaceous, of variable size quartz grains, some up to .05 mm., embedded in a matrix of much finer material, with a clear cement; aperture terminal, central, simple.

Length of holotype (Fig. 21) .64 mm; width of coiled portion .23 mm.;, length of coiled portion .18 mm.; length of ultimate chamber .22 mm.; width of ultimate chamber .17 mm.

Length of paratype (Fig. 20) .4 mm.; width of coiled portion .2 mm.; length of coiled portion .13 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 747.5 feet, 15.5 feet above the top of the "Spirit River" sand.

Paratype locality: - Imperial Oil Limited Surface Division locality G45-4 in Lsd. 3, Sec. 16, Tp. 79, Rge. 13- W 6th Meridian, at Henderson Creek, Alberta, from a footage of 55 below the "white chalcedonic bed" or approximately 145 feet above the projected top of the Pouce Coupe sand.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, this species is a distinctive fossil of the Ammobaculites ST-747-A zone, bearing its name, and is confined to the zone. At the Dunvegan locality of S47-27, the species occurs directly above the "Spirit River" sand equivalent. It is found at the Pouce Coupe River localities of G45-6 and G45-19 from the interval, 0 to 50 feet above the Pouce Coupe sand. At the Henderson Creek localities of G45-4 and G45-3, several specimens are found in the interval 135 to 150 feet above the projected top of the Pouce Coupe sand at the former locality, while three isolated occurrences are recorded from a bed 100 feet stratigraphically higher at the latter locality.

Comparison: - This species is identical to Ammobaculites 28-9-A of Stelck from the base of the "Spirit River" sand equivalent, at the Dunvegan locality of S47-28. Dr. Stelck's hypotype is very similar to the writer's paratype.

Ammobaculites ST-745-A

Plate II, Fig. 18, 19.

Test fairly robust, cylindrical in cross-section, but usually found considerably flattened due to distortion in fossilization; early portion closely coiled, generally comprising about half of test, with four or five chambers visible; later portion, nearly always bent, of two approximately equal chambers, rarely two and one-half to three, in uniserial arrangement; sutures oblique, depressed, distinct in partially pyritized, cylindrical specimens, fainter in flattened, non-pyritized forms; wall arenaceous, with quartz grains of about .025 mm., amount of cement not great; aperture terminal, central, simple.

Length of holotype (Fig. 18) .5 mm.; diameter of coiled portion .29 mm.; length of ultimate chamber .15 mm.; width of ultimate chamber .22 mm.

Length of paratype (Fig. 19) .47 mm.; diameter of coiled portion .32 mm.; length of ultimate chamber .18 mm.; width of ultimate chamber .24 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 745 feet, 18 feet above the top of the "Spirit River" sand.

Paratype locality: - as above, same depth.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, this rather frequently occurring species is confined to the _Ammobaculites ST-747-A_ zone, and could thus be listed as a post-Pouce Coupe guide fossil. It does not occur commonly in other areas, but at the Dunvegan locality of S47-27, one questionable form is found 2 feet above the "Spirit River" sand equivalent, while at the Pouce Coupe River locality of G45-6, some specimens are recorded at a footage of 40 above the Pouce Coupe sand.

Comparison: - This species seems to represent a more mature development of _Ammobaculites G45-19-0-A_ from the same zone.

Genus AMMOMARGINULINA Wiesner, 1931

Ammomarginulina ST-956-A

Plate I, Fig. 7, 8.

Test somewhat compressed, with early portion close coiled revealing five chambers in ultimate whorl; later portion, of three to four chambers, in slightly curved unilinear series, nearly equal in size except for ultimate one which is considerably longer and pyriform; sutures indisticnt in non-pyritized forms, oblique, slightly arcuate; wall finely arenaceous with grains averaging .015 mm.; a few up to .03 mm., amount of cement not great; aperture elliptical, terminal.

Length of holotype (Fig. 7) .64 mm.

Length of paratype (Fig. 8) .74 mm.; diameter of coiled portion of paratype .25 mm.; length of ultimate chamber of paratype .22 mm.; width of ultimate chamber of paratype .24 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 956 feet, 99 feet above the projected base of the Kaskapau formation.

Paratype locality: - Imperial Oil Limited Spirit River #1 Well in Lsd. 12, Sec. 20, Tp. 78, Rge. 6- W 6th Meridian, Alberta, at a depth of 1062 feet, 47 feet above the base of the Kaskapau formation.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, this pre-Pouce Coupe form is restricted to the Ammobaculites ST-930-A zone, with maximum

development occurring at a footage of 45 above the base of the Kaskapau. It is uncertain whether or not this species occurs outside of the Spirit River Area, but at the Dunvegan locality of C47-9, one questionable specimen is found at a footage of 105 above the base of the Kaskapau. In addition, one doubtful form was recovered from the Doe Creek locality of G45-5 at a footage of 80 above the base of the Kaskapau.

Comparison: - This form is rather closely related to Ammobaculites? 4-196-C of Stelck from the Deo Creek locality of S47-4 at a footage of 196 below the Pouce Coupe sand or 74 above the base of the Kaskapau formation. However, Stelck's species is smaller in size, more scaphitoid in outline, and has more oblique sutures than has the writer's species.

Ammomarginulina ST-956-B

Plate I, Fig. 13.

Test compressed, flat, wide, with early portion close coiled and comprising one-third to one-half of test, five chambers in ultimate whorl; uncoiled portion consisting of two chambers, penultimate one trapezoid-shaped; sutures indistinct in non-pyritized specimens, depressed, oblique, very slightly arcuate, with ultimate suture extending back almost to coiled portion; wall finely arenaceous, grains averaging .03 mm., amount of cement not great; aperture elliptical, terminal.

Length of holotype .58 mm.; diameter of coiled portion .33 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure

Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 956 feet, 99 feet above the projected base of the Kaskapau formation.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, this species occurs more commonly in the Ammobaculites ST-930-A zone (with almost equal numbers of specimens being recorded at footages of 47 and 96 above the base of the Kaskapau) than in the overlying Gaudryina ST-876-A zone, and is not found above the Pouce Coupe sand equivalent. One questionable specimen is found at the Dunvegan locality of C47-9, from a footage of 115 above the base of the Kaskapau. In the western part of the report area, at the Doe Creek localities of G45-5 and S47-4, maximum development occurs at footages of approximately 75 above the base of the Kaskapau.

Genus DOROTHIA Plummer, 1931

Dorothia ST-830-A

Plate II, Fig. 7.

Test rather stubby, usually found in a pyritized or partially pyritized state, rarely non-pyritized; first two whorls of four to five chambers each, followed by about one and one-half whorls of chambers in triserial arrangement, last three or four chambers added biserially; sutures slightly depressed, fairly distinct in pyritized forms; wall finely arenaceous, grains of .01 mm., or smaller, considerable amount of cement; aperture an arch at the inner margin of the terminal face.

Length of holotype .31 mm.; maximum width of holotype .13 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 830 feet, 12 feet above the top of the Pouce Coupe sand equivalent.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This post-Pouce Coupe species has not been recognized outside of the Spirit River Area, where it is confined to the Ammobaculites ST-747-A zone, with maximum development occurring in the interval 2 to 12 feet above the Pouce Coupe sand equivalent.

Dorothia ST-834-A

Plate II, Fig. 8.

Test slender, elongate, generally preserved as a pyritized or partially pyritized replacement; first two whorls of four to five chambers each, followed by about four twisted whorls of much larger chambers arranged triserially, final two chambers added biserially; sutures slightly depressed, fairly distinct in pyritized forms; wall finely arenaceous, grains of .01 mm., or smaller, considerable amount of cement; aperture an arch at the inner margin of the terminal face.

Length of holotype .34 mm.; maximum width .1 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 834 feet, 8 feet above the top of the Pouce Coupe sand equivalent.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This post-Pouce Coupe species has not been recognized outside of the Spirit River Area, where in close association with *Dorothia ST-830-A*, it is confined to the *Ammobaculites ST-747-A* zone. Maximum development occurs at the same level as does *Dorothia ST-830-A*, that is in the interval 2 to 12 feet above the Pouce Coupe sand equivalent.

Comparison: - This form is closely related to *Dorothia ST-830-A*. However, *Dorothia ST-834-A* differs in being more slender, and in having a longer triserial portion. The last three chambers of this form are

similar to those of Dorothia ST-830-A, and if they are to be of the same subspecies, implies a microspheric-megalospheric relationship, of a rather rare type, in which the microspheric test is relatively smaller.

Genus FLABELLAMMINA Cushman, 1928

Flabellammina SR-1013-A

Plate I, Fig. 22, 23.

Test compressed, nearly flat, periphery rounded in mature specimens, early portion fairly small, closely coiled with about five chambers visible; later portion of four rapidly enlarging chambers, first three triangular in shape, ultimate trapezoid; sutures flush or slightly depressed, obscure, arcuate, all reaching back to coiled portion; wall arenaceous, with grains averaging about .02 mm., in mature specimens, moderate amount of cement (younger specimens and some outcrop forms have smaller grains and more cement), finish not too smooth; aperture terminal, elliptical, at the distal end of the final chamber in mature specimens, below the outer point of the ultimate chamber in young forms.

Length of holotype (Fig. 22) .75 mm.; diameter of coiled portion .29 mm.

Length of paratype (Fig. 23) .45 mm.

Holotype locality: - Imperial Oil Limited Spirit River #1 Well in Lsd. 12, Sec. 20, Tp. 78, Rge. 6- W 6th Meridian, Alberta, at a depth of 1013 feet, 96 feet above the base of the Kaskapau formation.

Paratype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian,

Alberta, at a depth of 937.5 feet, 117.5 feet above the projected base of the Kaskapau formation.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This species occurs most characteristically in the *Ammobaculites* ST-930-A zone of the lower Kaskapau, being restricted to this zone at Spirit River, where the greatest number of specimens, particularly of the younger forms, are found at the extreme base of the formation, only 5 feet above the Dunvegan-Kaskapau contact. More mature forms occur most frequently at levels about 100 feet above the base of the formation at Spirit River. At the Doe Creek localities of G45-5 and S47-4, maximum development occurs at a footage of 90 above the base of the formation, with some specimens being found in the *Gaudryina* ST-876-A zone. Only one specimen has been identified at the Dunvegan locality of C47-9 from a footage of 95 above the base of the Kaskapau.

Flabellammina SR-1011-A

Plate I, Fig. 18, 19.

Test compressed, usually found as a pyritized replacement, periphery narrowly rounded, early portion small, close coiled with four or five chambers visible; later portion of six gradually enlarging, sickle-shaped chambers; sutures flush, fairly distinct in pyritized or partly pyritized forms, obscure in non-pyritized forms, strongly arcuate in later portion, extending back toward coiled portion, but failing to reach same; wall, in non-pyritized forms, arenaceous, grains averaging about .015 mm., moderate amount of cement; in pyritized forms, appearing much

more smoothly finished with grain size imperceptable; aperture terminal, elliptical, slightly produced.

Length of holotype (Fig. 18) .79 mm.; diameter of coiled portion .2 mm.

Length of paratype (Fig. 19) .73 mm.

Holotype locality: - Imperial Oil Limited Spirit River #1 Well in Lsd. 12, Sec. 20, Tp. 78, Rge. 6- W 6th Meridian, Alberta, at a depth of 1011 feet, 98 feet above the base of the Kaskapau formation.

Paratype locality: - as above, at a depth of 1013 feet, 96 feet above the base of the Kaskapau formation.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This species is restricted to the Ammobaculites ST-930-A zone of the lower Kaskapau, attaining its acme at an approximate footage of 100 above the base of the formation at Spirit River. It has not been recognized at any of the other localities.

Flabellammina C47-9-95-A

Plate I, Fig. 24.

Test compressed, large, periphery broadly rounded, coiled portion small, with three or four chambers visible; later portion of five chambers, with four chambers of approximately equal size, first three elongate triangular-shaped, fourth elongate rectangular, followed by a considerably larger ultimate trapezoid chamber, giving truncated appearance to distal end of test; sutures slightly depressed, not too distinct, arcuate, all extending back to about the same point in coiled section, save ultimate one, which fails to reach early portion; wall of sharply angular quartz grains, averaging about .04 mm., but some almost twice this size, neatly placed in a flat mosaic on the later chambers, embedded in a matrix of much finer, light orange, arenaceous cementing material; aperture terminal, elliptical.

Length of holotype .89 mm.; maximum width .6 mm.

Holotype locality: - Imperial Oil Limited Surface Division Locality C47-9 in Sec. 8, Tp. 80, Rge. 4- W 6th Meridian, on the north bank of the Pouce Coupe River, about one-half mile downstream from the ferry at Dunvegan, Alberta.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This species is restricted to the Ammobaculites ST-930-A zone of the lower Kaskapau at Dunvegan and Spirit River. It occurs most commonly at the Dunvegan locality of C47-9, with maximum development being recorded at a footage of 95 above the base of the formation. At Spirit River the acme of the species occurs at a footage of 111 above the base of the Kaskapau. Several questionable occurrences are noted from the Doe Creek locality G45-5 at various footages above the Kaskapau base.

Flabellammina ST-937-A

Plate I, Fig. 25, 26.

Test much compressed, oblong, elongate, early portion close coiled, indistinct, about three chambers visible; later portion of four chambers, ultimate chamber somewhat larger than penultimate one, but often distorted and appearing much larger than its true size (as in paratype, Fig. 26); sutures slightly depressed, faint in subsurface forms, generally more distinct in surface specimens, oblique and slightly arcuate, extending back towards coiled portion, but ultimate one and usually penultimate one also failing to reach same; wall arenaceous, grains of about .015 mm. in subsurface forms, .02 mm. in surface forms, with a moderate amount of cement, apparently more in surface specimens, which usually have a smoother finish; aperture terminal, elliptical.

Length of holotype (Fig. 25) .82 mm.

Length of paratype (Fig. 26) .82 mm.; maximum length of ultimate chamber .44 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1, in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 937 feet, 118 feet above the projected base of the Kaskapau formation.

Paratype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta, at a footage of 105 below the base of the Pouce Coupe sand.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, this species is restricted to the Ammobaculites ST-930-A zone of the basal Kaskapau, with maximum development being noted, at a footage of 115 above the base. This form occurs more commonly in the Ammobaculites ST-930-A zone at the Doe Creek locality of G45-5, with maximum development occurring at a footage of 155 above the base of the Kaskapau, but with some specimens being observed in the overlying Gaudryina ST-876-A zone.

Flabellammina G45-5-115-A

Plate I, Fig. 21.

Test attenuated pear-shaped, periphery narrowly rounded, early portion closely coiled, small, with three chambers visible; uncoiled portion of three rapidly enlarging chambers, antepenultimate one triangular-shaped, later two trapezoid in outline; sutures fairly distinct, depressed, with later two slightly arcuate, extending back to coiled portion; wall of variable size quartz grains, the largest being .11 mm., embedded in a matrix of much finer, yellow, arenaceous cementing material; aperture terminal, elliptical.

Length of holotype .75 mm.; maximum width of holotype .37 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta at a footage of 115 below the base of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This form has not been positively recognized outside of the Doe Creek locality of G45-5, where it is confined to the

Ammobaculites ST-930-A zone of the lower Kaskapau, with maximum development occurring at a footage of 115 below the base of the Pouce Coupe sand, or 155 feet above the base of the Kaskapau. At Spirit River, several questionable specimens were recovered at a footage of 113 above the base of the Kaskapau.

Flabellammina G45-5-110-B

Plate I, Fig. 20.

Test elongate, rectangular in cross-section in well preserved specimens, usually found considerably flattened, early portion tightly coiled and involute, with three chambers visible; later uncoiled portion consisting of three chambers, antepenultimate one roughly triangular-shaped, with last two rhomboidal; sutures flush in coiled portion, slightly depressed in uniserial part, last two slightly arcuate with penultimate one extending back to initial chamber of coiled portion; wall of variable size quartz grains, with the odd one up to .11 mm., embedded in a matrix of much finer, yellow and grey, arenaceous cementing material, giving a smooth overall finish to the exterior; aperture terminal, elliptical, silt-like.

Length of holotype .72 mm.; width of coiled portion .27 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta, at a footage of 110 below the base of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This form has not been identified outside of the Doe Creek locality G45-5, where it reaches its acme at a footage of 175 above the base of the Kaskapau, and also occurs sporadically in the overlying Gaudryina ST-876-A zone.

Flabellammina G45-5-105-A

Plate I, Fig. 27.

Test compressed, flattened, small, early portion closely coiled with slightly over four chambers visible, later portion consisting of two chambers; sutures flush to slightly depressed in coiled portion, somewhat thickened, fairly distinct, ultimate one arcuate and bending back to first chamber of coiled portion; wall finely arenaceous but studded with a few quartz grains of between .02 and .03 mm., considerable amount of cement giving a smooth external appearance; aperture terminal, a narrow, elongate slit.

Length of holotype .45 mm.; diameter of coiled portion .26 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp.81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta, at a footage of 105 below the base of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This species has been recognized only in the western part of the report area, at the Doe Creek localities of G45-5 and S47-4, where it is restricted to the Ammobaculites ST-930-A zone of the basal Kaskapau, with maximum development occurring at a footage of 155 above the base of the Kaskapau.

Flabellammina G45-5-105-B

Plate I, Fig. 17.

Test compressed, small, roughly rectangular in outline, early portion closely coiled, revealing about four chambers in ultimate whorl, one side not completely involute, opposite side involute, revealing only three chambers; later portion of two chambers, ultimate chamber rhomboidal in shape and much larger than penultimate chamber; last two chambers appearing equal in size on more involute side of test; where penultimate chamber is triangular-shaped; sutures flush, fairly distinct in most specimens, ultimate suture slightly arcuate, extending back to coiled portion; wall finely arenaceous, but with a few scattered grains up to .05 mm., sporadically placed, considerable amount of cement giving smooth finish to exterior; aperture terminal, elliptical, slit-like.

Length of holotype .44 mm.; width of coiled portion .29 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-5, in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta, at a footage of 105 below the base of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This species seems to be restricted to the *Ammobaculites ST-930-A* zone of the lower Kaskapau. At the Doe Creek localities of G45-5 and S47-4, maximum development occurs at a footage of 155 above the base of the Kaskapau. One positive and one doubtful identification have been made at the Dunvegan locality of C47-9 at a footage of 95 above

the base of the Kaskapau. Flabellammina G45-5-105-B has not been found in the Spirit River section.

Comparison: - This species is identical to Flabellammina 4-97-B of Stelck from the Doe Creek locality of S47-4 at a footage of 97 below the Pouce Coupe sand.

This form probably stands in varietal or immature relationship to Flabellammina G45-5-110-B, and differs from Flabellammina G45-5-105-A in lacking bilateral symmetry.

Flabellammina G45-3-50-A

Plate III, Fig. 17,18.

Test compressed, periphery rounded, of six external chambers; chambers obscured, first four small, of approximately equal size, last two much larger, and comprising about four-fifths of the size of the test; sutures indistinct, obscured by the overlapping margins of the later chambers, arcuate, extending back to coiled portion; wall arenaceous, with quartz grains averaging .04 mm., occasional grain up to .1 mm., embedded in a fair amount of cement, but surface rather rough and uneven; aperture terminal, slightly produced, possibly elliptical.

Length of holotype (Fig. 17) .67 mm.; maximum width .53 mm.

Length of paratype (Fig. 18) .64 mm.; maximum width .47 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-3 in Lsd. 12, Sec. 15, Tp. 79, Rge. 13- W 6th Meridian on Henderson Creek, Alberta, at a footage of 50 feet above the "white chalcedonic bed", or about 250 feet above the projected top of the Pouce Coupe sand.

Paratype locality: - Imperial Oil Limited Surface Division locality S47-36 in Tp. 78, Rge. 17- W 6th Meridian, on the west bank of the Kiskatinaw River, one mile downstream from Arras, British Columbia, at a footage of 85 below the "white chalcedonic bed".

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This species occurs in the central part of the Kaskapau formation, above the Pouce Coupe sand, and both above and below the "white chalcedonic bed", in the Pouce Coupe and Kiskatinaw River Areas. At the Henderson Creek localities of G45-4 and G45-3, the form, occurring above the Ammobaculites ST-747-A zone, ranges over an interval from 35 feet below the "white chalcedonic bed" to 65 feet above it (265 feet above the projected top of the Pouce Coupe sand). At the Kiskatinaw River locality of S47-36, this species occurs rarely in the interval 60 to 80 feet above the Pouce Coupe sand. Only one specimen has been found in the Spirit River section, near the base of the Ammobaculites ST-747-A zone, at an approximate footage of 34 above the top of the "Spirit River" sand (113 feet above the Pouce Coupe sand).

Flabellammina G45-3-145-A

Plate III, Fig. 16.

Test compressed, periphery narrowly rounded, early portion not tightly coiled, with about six chambers visible in final volution; later portion of five or six wedge-shaped chambers, penultimate one the largest; sutures indistinct in most specimens, flush, oblique, ultimate one arcuate and extending almost back to coiled portion; wall finely arenaceous, considerable amount of cement, giving a smooth finish to part or all of test; aperture terminal, slightly produced, possibly elliptical.

Length of holotype .74 mm.; maximum width .38 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-3 in Lsd. 12, Sec. 15, Tp. 79, Rge. 13- W 6th Meridian, on Henderson Creek, Alberta, at a footage of 145 above the "white chalcedonic bed" or about 345 feet above the projected top of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This species occurs rather commonly in the central portion of the Kaskapau, above the Pouce Coupe sand, and both above and below the "white chalcedonic bed". At the Henderson Creek localities of G45-4 and G45-3, the form ranges over an interval from the top of the *Ammobaculites ST-747-A* zone (45 feet below the "white chalcedonic bed") to the top of the sampled section, that is 150 feet above the "white chalcedonic bed", with the maximum development occurring at a footage of 140 feet above this marker (340 feet above the projected

top of the Pouce Coupe sand). At the Kiskatinaw River locality of S47-36, specimens were recovered in the interval, beginning 10 or 20 feet above the Pouce Coupe sand, and extending upwards to the "white chalcedonic bed". This species has not been recognized in the eastern part of the report area.

Comparison: - This form is very similar to Flabellammina 36-118-B of Stelck, from the Kiskatinaw River locality of S47-36 at a footage of 118 below the "white chalcedonic bed". Dr. Stelck's figured specimen shows a more involute coiled portion than does the author's holotype, but beyond this minor detail, the forms appear to be identical.

Genus GAUDRYINA d'Orbigny, 1839

Gaudryina SR-1018-A

Plate II, Fig. 9, 10.

Test small, twisted; early triserial portion of about three whorls, later biserial portion of two whorls; sutures fairly distinct, depressed; wall finely arenaceous, the largest grains about .01 mm., with a considerable amount of cement, giving a rather smooth exterior finish, particularly noticeable in surface specimens; aperture a notch at the inner margin of the ultimate chamber, extending well up on to the terminal face.

Length of holotype (Fig. 9) .31 mm.; maximum width .14 mm.

Length of paratype (Fig. 10) .24 mm.; maximum width .12 mm.

Holotype locality: - Imperial Oil Limited Spirit River #1 Well in Lsd. 12, Sec. 20, Tp. 78, Rge. 6- W 6th Meridian, Alberta, at a depth of 1018 feet, 91 feet above the base of the Kaskapau formation.

Paratype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian on Doe Creek, Alberta, at a footage of 115 below the base of the Pouce Coupe sand.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This species does not occur above the top of the Gaudryina ST-876-A zone, and thus can be listed as a pre-Pouce Coupe guide fossil. At Spirit River, about equal numbers of specimens were recovered at footages of 90 and 137 above the base of the Kaskapau. Several specimens were found at the Dunvegan locality of C47-9 at a footage of 125 above the base. At the Doe Creek localities of G45-5 and S47-4, maximum development occurs at an approximate footage of 140 above the base of the Kaskapau.

Comparison: - This species is identical to Gaudryina 4-186-A of Stelck from the Doe Creek locality of S47-4 at a footage of 186 below the base of the Pouce Coupe sand, or 84 feet above the base of the Kaskapau.

Gaudryina ST-876-A

Plate II, Fig. 4, 5.

Test elongate, early portion stubby, triserial, of about nine chambers (some forms, probably microspheric specimens, have an additional two whorls of tiny chambers at the base); intermediate triserial twisted portion of two to three whorls; biserial portion of four chambers; sutures fairly distinct, depressed; wall rather finely arenaceous, grains averaging about .015 mm., with a moderate amount of cement; aperture a deep notch at the inner margin of the ultimate chamber, extending well up on to the terminal face.

Length of holotype (Fig. 4) .52 mm.; maximum width .18 mm.

Length of paratype (Fig. 5) .43 mm.; maximum width .17 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 876 feet, 22 feet below the base of the Pouce Coupe sand equivalent.

Paratype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian on Doe Creek, Alberta, at a footage of 85 feet below the base of the Pouce Coupe sand.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This pre-Pouce Coupe form does not occur above the top of the zone bearing its name. At Spirit River, it occurs fairly commonly over an interval, 140 to 185 feet above the base of the Kaskapau, with maximum development apparently occurring at a footage of 150 above the

Dunvegan. Several specimens are found at the Dunvegan locality of C47-9 in samples taken at footages of 125 and 135 (top of the sampled section) above the base of the Kaskapau. At the Doe Creek locality of G45-5, maximum development appears to occur at a footage of 175 above the base of the Kaskapau, with no positive identifications being recorded from higher levels.

Comparison: - This species is similar to _Gaudryina hectori_ Nauss from the Lloydminster shale of eastern Alberta, in that it is approximately the same size, has identical sutures, and the same general type of wall structure. However, _Gaudryina ST-876-A_ has a stouter triserial portion, and does not become biserial until rather late in its development, as opposed to the relatively long biserial stage in _Gaudryina hectori_. _Gaudryina ST-876-A_ has less cement than _G. hectori_, thus not appearing so smoothly finished as the latter.

Genus GLOBIGERINA d'Orbigny, 1826

Globigerina cretacea d'Orbigny, 1826

Plate III, Fig. 21, 22.

Test rather small, periphery rounded; test rotaloid, consisting of two and one-half whorls, with five chambers in both ultimate and penultimate volutions, spire low; ventral side of test with a well developed umbilicus; chambers globular, inflated to various degrees, not too loosely appressed; sutures distinct, depressed; wall calcareous, finely perforate, with surface hispid in many specimens, smoothly polished and hyaline in others; aperture large, opening into the umbilicus.

Diameter of plesiotype (Fig. 21) .2 mm.; thickness .12 mm.

Diameter of plesiotype (Fig. 22) .21 mm.

Plesiotype (Fig. 21) locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7-W 6th Meridian, Alberta, at a depth of 515 feet, 113 feet below the top of the Lower (Second) White Speckled Shale horizon of the Kaskapau formation.

Plesiotype (Fig. 22) locality: - as above, same footage.

Plesiotypes: - University of Alberta Paleontological Type Collection.

Range: - In the report area, this species has not been found outside of the Spirit River section, where it is restricted to the interval 8 to 188 feet below the top of the Lower Speckled Shale.

Remarks: - Globigerina cretacea, a universal Upper Cretaceous index fossil, has been reported, along with Gumbelina globulosa and

Gumbelitria cretacea, by Wickenden (1945, p. 33) from the Favel formation of Manitoba. Young (1951, p. 65) has recently reported this species from the "Vascoceras beds" of the Frontier formation of the Colorado group in southern Montana. In the Vermilion area of eastern Alberta, Nauss (1945, p. 1617) has reported the form from the Lloydminster shale (Colorado age). The writer has observed this species in well samples from the Second White Speckled Shale horizon of the Colorado group in the Edmonton area of central Alberta.

This pelagic form seems to have world-wide distribution and the name has been used to embrace a "form species". For these reasons, a critical synonomy is omitted as it would entail type specimen research in foreign museums.

Genus GUMBELINA Egger, 1899

Gumbelina globulosa (Ehrenberg), 1834

Plate III, Fig. 20.

For references, see U.S.G.S. Prof. Paper 206, p. 105.

Test very small, tapering, usually the widest part across the last two chambers, but occasionally across the second last pair of chambers; chambers, twelve in biserial arrangement, expanding rapidly in size, especially in last three pairs, inflated, globular; sutures distinct, depressed, oblique to the long axis of test; wall calcareous, finely perforate, smooth, occasionally hyaline; aperture a broadly arched opening at the inner margin of the last chamber.

Length of plesiotype .19 mm.; maximum width .13 mm.

Plesiotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian,

Alberta, at a depth of 562 feet, 160 feet below the top of the Lower (Second) White Speckled Shale horizon of the Kaskapau formation.

Plesiotype: - University of Alberta Paleontological Type Collection.

Range: - In the report area, this species has not been found outside of the Spirit River section, where it is restricted to the interval 8 to 182 feet below the top of the Lower Speckled Shale.

Remarks: The discussion under *Globigerina cretacea* is applicable here also, since the two forms occur in close association.

In addition, according to Cushman (1946, p. 106), "This species in Europe seems to occur mainly in the Senonian and Maestrichtian and in America apparently ranges downward from horizons as high as the Kemp Clay at the top of the Navarro group to horizons as low as at least the middle part of the Taylor marl, with rare occurrences below. It apparently developed from *Gumbelina reussi* which occurs in the lower part of the section and does not have the earlier chambers so globose." Cushman questioned the identification of *Gumbelina globulosa* from the Niobrara and other chalks of the Kansas-Nebraska region, and thought that possibly such forms might be identified as *G. reussi* upon examination of the original material. It would therefore follow that the Western Canadian forms, identified as *G. globulosa* from correlative formations of Turonian age, might be more correctly included under *G. reussi*. However, the writer decided to continue to include this form under *G. globulosa*, after comparing it with specimens of the species recovered from a sample of the Taylor Marl, taken at a clay pit, two miles west of Taylor, Texas.

Genus GUMBELITRIA Cushman, 1933

Gumbelitria ST-782-A

Plate II, Fig. 11.

Test gradually tapering, twisted about one-third of the distance from the apertural end, where the chamber arrangement changes from three to two to a whorl; chambers, eighteen in triserial portion, three to four in biserial portion, expanding rather rapidly, and inflated, with those in biserial portion much larger and more inflated than the earlier chambers; sutures distinct, depressed; wall calcareous, finely perforate; aperture a large semi-circular opening at the inner margin of the ultimate chamber.

Length of holotype .28 mm.; maximum width .12 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 782 feet, 60 feet above the top of the Pouce Coupe sand equivalent.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This rather rare form is restricted for the most part to the Ammobaculites ST-747-A zone of the central Kaskapau, with one isolated occurrence being recorded in the Ammobaculites ST-930-A zone of the lower Kaskapau. It has not been recognized outside of the Spirit River Area.

Remarks: - Possibly, this species should be referred to the genus Neobulimina, but tentatively the writer has decided to

classify it under Gumbelitria, because of its large, semi-circular aperture, and again, because biseriality is not developed until a very late stage.

Gumbelitria cretacea Cushman, 1933

Plate III, Fig. 23, 24.

For references, see U.S.G.S. Prof. Paper 206, p. 103.

Test small, gradually tapering, rounded triangular in cross-section; test triserial, with five whorls of three chambers each; chambers gradually expanding, partly inflated, subglobular; sutures distinct, depressed; wall calcareous, finely perforate,often polished smooth in places and appearing hyaline; aperture a narrowly rounded, prominent, arched opening at the inner margin of the last chamber.

Length of plesiotype (Fig. 23) .22 mm.; maximum width .11 mm.

Length of plesiotype (Fig. 24) .21 mm.; maximum width .13 mm.

Plesiotype (Fig. 23) locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7-W 6th Meridian, Alberta, at a depth of 562 feet, 160 feet below the top of the Lower (Second) White Speckled Shale horizon of the Kaskapau formation.

Plesiotype (Fig. 24) locality: - as above, at a depth of 566 feet.

Plesiotypes: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, this species occurs commonly over the interval 58 to 188 feet below the Lower Speckled Shale in association

with Globigerina cretacea and Gumbelina globulosa, but unlike the latter two, which are not found below this point, it ranges down into beds of the Ammobaculites ST-747-A zone, and occurs very rarely in the Gaudryina ST-876-A zone, that is below the Pouce Coupe sand equivalent. Gumbelitria cretacea has not been found outside of Spirit River in the report area.

Remarks: - Gumbelitria cretacea has a wide distribution in the Upper Cretaceous rocks of the western hemisphere. Cushman (1946, p. 103) has reported the form from the Upper Cretaceous of Colombia, South America, from the Navarro group in the Gulf Coast Region of the United States, and from the Upper Cretaceous of New Jersey. Wickenden (1945, p. 33) reports the species from the Favel formation of southern Manitoba, and the writer has seen the form in well samples from the Second White Speckled Shale horizon of the Colorado group in the Edmonton area of central Alberta.

Gumbelitria ST-596-A

Plate III, Fig. 19.

Test of medium size, gradually tapering, consisting of eight whorls of three chambers each; chambers, rather gradually increasing in size, somewhat inflated, final three the largest and most inflated; sutures distinct, depressed; wall calcareous, finely perforate, often polished smooth in places and appearing hyaline; aperture a wide semi-elliptical opening at the inner margin of the ultimate chamber.

Length of holotype .31 mm.; maximum width .15 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7-W 6th Meridian, Alberta, at a depth of 596 feet, 194 feet below the top of the Lower (Second) White Speckled Shale horizon of the Kaskapau formation.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - In the Spirit River Area, this form occurs in close association with Gumbelitria cretacea, but is not nearly as common as the latter form. It has not been observed above a point in the section, about 150 feet below the top of the Lower Speckled Shale, but like G. cretacea, it ranges down into the lower Kaskapau beds.

Comparison: - This form seems to be very closely related to G. cretacea, and is probably either the microspheric stage of the latter species or an elongate variety of it. In many cases, where this form is broken, it is very difficult, if not impossible, to distinguish it from G. cretacea. Thus, some of the specimens recorded under G. cretacea in the microfaunal log may actually belong to G. ST-596-A.

Genus HAPLOPHRAGMOIDES Cushman, 1910

Haplophragmoides SR-1018-B

Plate II, Fig. 16, 17.

Test minute, found only as a pyrite replacement, compressed, periphery rounded; test planispiral, closely coiled with a moderate umbilical development, not completely involute, with about three chambers visible in penultimate whorl; chambers, six in ultimate whorl, last three of about equal size, and much larger than first three; sutures distinct, depressed, first three straight, last two slightly curved; wall structures not positively known, seems to be of constant, very fine, grain size, with much cement; aperture, a very low, narrow arch at the base of the terminal face.

Diameter of holotype (Fig. 16) .18 mm.

Diameter of paratype (Fig. 17) .14 mm.; thickness .06 mm.

Holotype locality: - Imperial Oil Limited Spirit River #1 Well in Lsd. 12, Sec. 20, Tp. 78, Rge. 6- W 6th Meridian, Alberta, at a depth of 1018 feet, 91 feet above the base of the Kaskapau formation.

Paratype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 834 feet, 8 feet above the top of the Pouce Coupe sand equivalent.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This species occurs in the lower and lower central parts of the Kaskapau, not being found above the Ammobaculites ST-747-A zone. At Spirit River, most of the recorded occurrences are from levels below the Pouce Coupe sand equivalent, while at the Doe Creek localities of G45-5 and S47-4, all of the specimens were recovered from beds below the Pouce Coupe sand.

Comparison: - This species is rather similar to Haplophragmoides ST-902-A, and may well be ancestral to it. H. SR-1018-B differs mainly from H. ST-902-A in being somewhat smaller in size, more umbilicate, and less involute.

Haplophragmoides SR-1011-B

Plate II, Fig.32, 33.

Test minute, usually found as a pyrite replacement, periphery rounded; test planispirally coiled, evolute, with umbilicus exposing preceding whorl; chambers, of approximately equal size, seven to seven and one-half visible in ultimate whorl, five or six in penultimate whorl; sutures distinct, flush, slightly curved; wall very finely arenaceous, with much cement, giving a smooth external finish; aperture semilunar at the base and slightly to one side of the terminal face, extending part way to the umbilical region.

Diameter of holotype (Fig. 32) .11 mm.; thickness .06 mm.

Diameter of paratype (Fig. 33) .12 mm.

Holotype locality: - Imperial Oil Limited Spirit River #1 Well in Lsd. 12, Sec. 20, Tp. 78, Rge. 6- W 6th Meridian, Alberta, at a depth of 1011 feet, 98 feet above the base of the Kaskapau formation.

Paratype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta, at a footage of 85 below the base of the Pouce Coupe sand.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This species occurs in the lower and lower central parts of the Kaskapau, not being found above the Ammobaculites ST-747-A zone. At Spirit River, most of the recorded occurrences are from beds below the Pouce Coupe sand equivalent. A few specimens are found in the pre-Pouce Coupe beds at the Doe Creek localities of G45-5 and S47-4, while one specimen was recovered at a footage of 15 above the top of the Pouce Coupe sand at the Pouce Coupe River locality of G45-19. A questionable occurrence was recorded at the Dunvegan locality of C47-9 from a footage of 95 above the base of the Kaskapau.

Comparison: - This species is very closely related to Haplophragmoides ST-958-A, the only major point of difference between the two species being the presence of one and one-half to two additional chambers in the ultimate whorl of H. ST-958-A.

Haplophragmoides ST-958-A

Plate I, Fig. 9, 10.

Test minute, usually found as a pyrite replacement, periphery rounded; test planispirally coiled, evolute, with umbilicus exposing preceding whorl; chambers, of approximately equal size, nine visible in ultimate whorl, six in penultimate whorl; sutures distinct, flush, somewhat thickened, first four in ultimate whorl curved, last four straight; wall very finely arenaceous, with much cement giving a smooth finish to external surface; aperture, a low arch at the base of the terminal face.

Diameter of holotype (Fig. 9) .14 mm.; thickness .06 mm.

Diameter of paratype (Fig. 10) .16 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 958 feet, 97 feet above the projected base of the Kaskapau formation.

Paratype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta, at a footage of 110 below the base of the Pouce Coupe sand.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, this species is restricted to the pre-Pouce Coupe beds, attaining its acme in the *Ammobaculites ST-930-A* zone at a footage of 98 above the base of the Kaskapau, and not commonly occurring above the zone. This form is also confined to the pre-Pouce

Coupe beds at the Doe Creek localities of G45-5 and S47-4, with the most forms being recovered at the former locality from a footage of 155 above the base of the Kaskapau.

Comparison: - This species is very closely related to Haplophragmoides SR-1011-A, the only major point of difference between the two forms being the existence of one and one-half to two additional chambers in the ultimate whorl of Haplophragmoides ST-958-A.

Haplophragmoides ST-902-A

Plate II, Fig. 22, 23.

Test small to medium, generally found in a pyritized or partially pyritized state, somewhat compressed, periphery rounded, polygonal in outline, test planispiral, rather tightly coiled, nearly involute, with only small portions of last three chambers of penultimate whorl visible; chambers, five in ultimate whorl, last four of approximately equal size, initial one considerably smaller; sutures distinct, flush, curved, last two slightly sigmoidal and slightly limbate; wall rather finely arenaceous, moderate amount of cement, outcrop specimens smoothly finished; aperture, a low wide slit at the base of the terminal face.

Diameter of holotype (Fig. 22) .24 mm.; thickness .11 mm.

Diameter of paratype (Fig. 23) .29 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 902.5 feet, 152.5 feet above the projected base of the Kaskapau formation.

Paratype locality: - as above, at a depth of 898 feet, 157 feet above the projected base of the Kaskapau.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This species occurs characteristically in the Gaudryina ST-876-A zone of the lower Kaskapau. At Spirit River it is found commonly in the interval 139 to 195 feet above the base of the Kaskapau, reaching its acme at a footage of 179 above the base, that is, 22 feet below the base of Pouce Coupe sand equivalent, and not often occurring above this horizon. At the Doe Creek localities of G45-5 and S47-4, maximum development occurs at a footage of 250 above the base of the Kaskapau or 20 feet below the base of the Pouce Coupe sand. A concentration of specimens was recovered at the Dunvegan locality of C47-9, from a footage of 115 above the base of the Kaskapau.

Comparison: - This species is rather similar to Haplophragmoides SR-1018-B and may be descended from it. H. ST-902-A differs mainly from H. SR-1018-B in being somewhat larger in size, not noticeably umbilicate, and more involute.

Flattened forms of H. ST-902-A bear a resemblance to specimens of Haplophragmoides G45-4-55-A. The latter species is generally larger in size, has at least one additional chamber in the ultimate whorl, and its sutures are radial, as compared to the curved and sigmoidal development in those of H. ST-902-A.

Haplophragmoides G45-5-85-A

Plate II, Fig. 30, 31.

Test compressed, rather schaphitoid in outline, venter broadly rounded; test planispirally coiled, evolute, with umbilicus exposing preceding whorl; chambers, gradually enlarging, eight in ultimate whorl, six in penultimate whorl; sutures distinct, slightly depressed, early ones curved, sigmoidal in some specimens, last four sigmoidal; wall very finely arenaceous, with much cement giving a smooth, yellow-orange, exterior finish; aperture not definitely observed, believed to be a low opening at the base and to one side of the terminal face, extending part way toward the umbilicus.

Length of holotype (Fig. 30) .3 mm.; diameter .22 mm.

Length of paratype (Fig. 31) .37 mm., diameter .31 mm.; thickness .11 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta, at a footage of 85 below the base of the Pouce Coupe sand.

Paratype locality: - As above, at a footage of 110 below the base of the Pouce Coupe sand.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - At the Doe Creek localities of G45-5 and S47-4, the species is restricted to the pre-Pouce Coupe beds, with the acme occurring at the former locality, at a footage of 180 above the base of the Kaskapau, that is, on the borderline between the Ammobaculites

ST-930-A and Gaudryina ST-876-A zones. Several specimens are noted at Spirit River from the A. ST-930-A zone, but no positive identification has been made above it. At the Dunvegan locality of C47-9, a couple of specimens are observed in the A. ST-930-A zone, at a footage of 95 above the base of the Kaskapau.

Remarks: - In the Spirit River subsurface section, it is difficult to distinguish this form from some compressed, flattened, and partially pyritized forms of Haplophragmoides ST-850-A. Compression sometimes tends to produce a sigmoidal development of the sutures in H. ST-850-A, and as the sigmoidal nature of the sutures of H. G45-5-85-A is its most striking specific characteristic, confusion may thus arise in differentiating between these two forms. However, the grain size of H. G45-5-85-A is never greater than .01 mm.

Haplophragmoides ST-850-A

Plate II, Fig. 24, 25, 26.

Test of fair size, exhibiting considerable variation in preservation, usually partly flattened, often partially pyritized, periphery rounded; test planispiral, partly evolute with umbilicus exposing four chambers of penultimate whorl; chambers very gradually enlarging, somewhat inflated, seven in ultimate whorl, first three and last four in groups of approximately equal size; sutures not very distinct, slightly depressed, slightly curved; wall arenaceous, grains averaging about .03 mm., with the occasional grain up to .05 mm. and larger, amount of cement not great; aperture, a triangular opening at the base of the ultimate chamber, situated at a point about one-third

of the distance from the equatorial plane to the umbilical region.

Diameter of holotype (Fig. 24) .43 mm.; thickness .18 mm.

Diameter of paratype (Fig. 25) .35 mm.; thickness .08 mm.

Diameter of paratype (Fig. 26) .35 mm.; thickness .13 mm.

Holotype (Fig. 24) locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7-W 6th Meridian, Alberta, at a depth of 850 feet, 8 feet below the top of the Pouce Coupe sand equivalent.

Paratype (Fig. 25) locality: - as above, at a depth of 758 feet, 5 feet above the top of the "Spirit River" sand.

Paratype (Fig. 26) locality: - as above, at a depth of 754 feet, 9 feet above the top of the "Spirit River" sand.

Holotype and Paratypes: - University of Alberta Paleontological Type Collection.

Range: - This species occurs commonly in the three lower microfaunal zones of the Kaskapau, being recovered from the Spirit River and Dunvegan sections in all three zones, and at Doe Creek from the lower two. The preservation varies considerably in this form, making it a difficult one to identify, and consequently reducing its value in correlation work.

Comparison: - This species is similar to Haplophragmoides collyra Nauss in having approximately the same number of chambers, nearly straight sutures, and the same type of aperture. However, the wall of H. ST-850-A is made up of much coarser quartz grains, and its chambers, although somewhat inflated, do not have the globular appearance as exhibited by Nauss's holotype.

Haplophragmoides ST-838-A

Plate II, Fig. 28, 29.

Test slightly compressed, small to medium in size, usually found as a pyrite replacement, periphery rounded; test planispiral, involute or nearly so, umbilicate; chambers of approximately equal size, seven and one-half to eight and one-half visible in ultimate whorl; sutures fairly distinct, slightly depressed, slightly curved, almost radial; wall arenaceous, grains averaging about .015 mm., held together by a moderate amount of cement; aperture, a low wide slit at the base of the terminal face.

Diameter of holotype (Fig. 28) .22 mm.; thickness .09 mm.

Diameter of paratype (Fig. 29) .25 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 838 feet, 4 feet above the top of the Pouce Coupe sand equivalent.

Paratype locality: - As above, at a depth of 750 feet, 13 feet above the top of the "Spirit River" sand.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, this species is confined to the Ammobaculites ST-747-A zone of the lower central Kaskapau, reaching its acme at a footage of 4 above the top of the Pouce Coupe sand equivalent. Two isolated occurrences were recorded at the Dunvegan localities of C47-9 and S47-27 from footages of 77 above the base of

the Kaskapau and 2 above the top of the "Spirit River" sand equivalent, respectively. It has not been observed in the Pouce Coupe Area.

Comparison: - This species is similar to Haplophragmoides linki Nauss in being involute, umbilicate, and in having the same type of wall structure and radial sutures. However, H. linki has inflated globular chambers, and a rounded periphery as opposed to the somewhat compressed chambers and the more angular appearance of H. ST-838-A. Furthermore, H. linki appears to be considerably thicker than this species.

H. ST-838-A is quite similar to Haplophragmoides glabra Cushman and Waters from the Upper Cretaceous Navarro formation of Texas. However, the sutures of the latter form are definitely curved, as opposed to the almost radial sutures of H. ST-838-A. Again, the holotype of H. glabra has one and one-half to two additional chambers.

Haplophragmoides ST-740-A

Plate II, Fig. 15.

Test somewhat compressed, periphery broadly rounded; planispiral, not completely involute with portion of penultimate whorl barely visible, slight umbilical development; chambers obscure, about six in ultimate whorl; sutures very faint, depressed, straight; wall coarsely arenaceous, grains averaging between .04 and .05 mm., with individual grains projecting from the finer cementing matrix by at least half of their thickness; aperture, a low slit at the base of the ultimate chamber, not often visible.

Diameter of holotype .38 mm.; thickness .11 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 740 feet, 23 feet above the top of the "Spirit River" sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This species occurs characteristically in the Ammobaculites ST-747-A zone of the lower central Kaskapau in association with A. G45-19-0-A. At Spirit River, only a few specimens were found below the Pouce Coupe sand equivalent, in the top beds of the Gaudryina ST-876-A zone. At the Dunvegan locality of S47-27, several specimens were recovered in a sample taken 2 feet above the "Spirit River" sand equivalent.

Comparison: - This species is very similar to Ammobaculites G45-19-0-A, the only major difference between the two forms being the position of the aperture, which is of course, terminal in Ammobaculites. In addition, it is often quite apparent from the outline of the last chamber in A. G45-19-0-A, that the form is tending to develop an uncoiled uniserial portion. It would seem that H. ST-740-A is the ancestral form of A. G45-19-0-A.

H. ST-740-A seems to be rather closely related to H. rugosa Cushman and Waters from the Upper Cretaceous Navarro formation of Texas. However, H. ST-740-A is a much more compressed form and lacks the prominent umbilicus of the Texas species. Furthermore, the quartz

grains in the Canadian form are not so neatly arranged, and there is considerably more cementing material holding them together than there is in the Texas species, which appears to have very little cement.

Again, H. ST-740-A is quite similar to H. calcula Cushman and Waters from the Navarro formation and earlier beds of Texas, but the latter form seems to have much more cementing material, and it of a finer nature, than does the Alberta species.

Haplophragmoides G46-1-10-A

Plate III, Fig. 5, 6.

Test not large, planispirally coiled, evolute, with umbilicus exposing preceding whorl; periphery rounded, shell compressed in some specimens; chambers, all approximately the same size, eight and one-half in ultimate whorl, six and one-half in penultimate whorl; sutures distinct, depressed, radial, somewhat thickened, especially toward the umbilical margins; wall very finely arenaceous, with much cement giving a smooth finish to the exterior; aperture, a low opening at the base of the terminal face. Color pale yellow.

Diameter of holotype (Fig. 5) .23 mm.; thickness .07 mm.

Diameter of paratype (Fig. 6) .25 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G46-1 in N.E. 1/4, Sec. 14, Tp. 79, Rge. 6- W 6th Meridian on Howard Creek, Alberta, at a footage of 10 above the top of the Ammobaculites ST-747-A zone, or about 30 feet above the "Spirit River" sand.

Paratype locality: - Imperial Oil Limited Surface Division locality G45-3 in Lsd. 12, Sec. 15, Tp. 79, Rge. 13- W 6th Meridian on Henderson Creek, Alberta, at a footage of 65 above the "white chalcedonic bed" or about 265 feet above the projected top of the Pouce Coupe sand.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This species is a post-Pouce Coupe form with a widespread occurrence over the report area. In the Howard Creek outcrop section, it occurs mainly in the interval 10 to 25 feet above the base of the _Haplophragmoides ST-664-A_ zone, that is, about 30 to 45 feet above the top of the "Spirit River" sand. At Spirit River, the form occurs over approximately the same interval, but due to poor core recovery, not very many specimens were recovered. At the Henderson Creek localities of G45-3 and G45-4, the species ranges over an interval from 55 feet below the "white chalcedonic bed" to the top of the sampled section, 150 feet above this bed, or about 350 feet above the projected top of the Pouce Coupe sand. _H. G46-1-10-A_ is present at the Pouce Coupe localities of G45-6 and G45-19 over an interval 10 to 20 feet above the Pouce Coupe sand. In the Kiskatinaw River section, it occurs over an interval from 74 feet below the "white chalcedonic bed" to 12 feet above it (70 to 157 feet above the Pouce Coupe sand). At the Dunvegan locality of S47-27, one specimen was recovered from a sample taken 2 feet above the "Spirit River" sand equivalent.

Comparison: - This species is identical to Haplophragmoides 36-32-A of Stelck, from the Kiskatinaw River locality of S47-36, at a footage of 32 below the "white chalcedonic bed".

H. G46-1-10-A is similar to H. ST-664-A in having about the same number of chambers, and in being evolute to about the same degree. However, the former species is considerably smaller and its sutures are radial and depressed, as opposed to the curved and flush sutures of H. ST-664-A. H. G46-1-10-A is also more smoothly finished than is H. ST-664-A, and has no quartz grains in its make-up larger than the cementing material, whereas the latter species does have some grains considerably larger than those in the matrix.

Haplophragmoides ST-664-A

Plate II, Fig. 27.

Plate III, Fig. 7, 8, 9.

Test of fair size, usually found in a flattened state as illustrated by paratype (Pl. III, Fig. 9) periphery rounded; test planispiral, partly evolute with umbilicus exposing about six chambers of penultimate whorl; chambers, eight and one-half to nine and one-half in ultimate whorl, very gradually enlarging in size; sutures distinct, except in crushed forms, where their presence is indicated by slight ridges, flush to slightly raised, thickened, curved; wall finely arenaceous, with an occasional grain of .015 mm. size, considerable amount of cement, giving a generally smooth finish to the exterior; aperture, a low triangular opening at the base of the ultimate chamber, slightly to one side of the equatorial region.

Diameter of holotype (Pl. III, Fig. 7) .38 mm.; thickness .09 mm.

Diameter of paratype (Pl. III, Fig. 8) .38 mm.; estimated thickness .025 mm.

Diameter of paratype (Pl. III, Fig. 9) .4 mm.; estimated thickness .025 mm.

Diameter of paratype (Pl. II, Fig. 27) .31 mm.; thickness .09 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 664 feet, 178 feet above the top of the Pouce Coupe sand equivalent.

Paratype (Pl. III, Fig. 8) locality: - as above, at a depth of 658 feet, 184 feet above the top of the Pouce Coupe sand equivalent.

Paratype (Pl. III, Fig. 9) locality: - as above, at a depth of 625 feet, 217 feet above the top of the Pouce Coupe sand equivalent.

Paratype (Pl. II, Fig. 27) locality: - as above, at a depth of 760 feet, 3 feet above the top of the "Spirit River" sand.

Holotype and Paratypes: - University of Alberta Paleontological Type Collection.

Range: - This species is characteristic of the central part of the Kaskapau at Spirit River, where it occurs abundantly in the zone bearing its name, that is, in the 150 feet of section, extending from 23 to 173 feet above the top of the "Spirit River" sand. It has not

been positively recognized outside of the Spirit River Area.

Comparison: - This species is similar to Haplophragmoides G46-1-10-A in having the same number of chambers, and in being evolute to about the same degree. However, this species is considerably larger and its sutures are curved and flush, as opposed to the radial and depressed sutures of H. G46-1-10-A. H. ST-664-A is not as smoothly finished as H. G46-1-10-A, and has some quartz grains of considerably larger size than its cementing material, whereas the grain size in H. G46-1-10-A is not distinguishable from the matrix.

Haplophragmoides G45-4-55-A

Plate III, Fig. 4.

Test somewhat compressed, of medium size, periphery rounded; test planispiral, partly evolute on one side with edge of penultimate whorl visible, opposite side involute; chambers, six to seven in ultimate whorl, last five of approximately equal size; sutures fairly distinct, flush, slightly thickened, slightly limbate toward the umbilicus, radial; wall finely arenaceous, with a considerable amount of cement, giving a smooth exterior finish; aperture, a low slit centrally situated at the base of the terminal face.

Diameter of holotype .41 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-4 in Lsd. 3, Sec. 16, Tp. 79, Rge. 13- W 6th Meridian, on Henderson Creek, Alberta, at a footage of 55 below the "white

chalcedonic bed" or a projected footage of 145 above the top of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This species occurs in the central portion of the Kaskapau formation in the western part of the report area, above the Pouce Coupe sand, and above and below the "white chalcedonic bed". At the Henderson Creek localities of G45-4 and G45-3, the most specimens were recovered at the base of the sampled section, that is, in the Ammobaculites ST-747-A zone, at a footage of 55 - 60 below the "white chalcedonic bed", while the highest recorded occurrences were at a footage of 80 above this bed, (280 feet above the projected top of the Pouce Coupe sand). At the Kiskatinaw River locality of S47-36, one specimen was found at a footage of 46 below the "white chalcedonic bed" or 98 feet above the Pouce Coupe sand.

Comparison: - This species is rather similar to flattened forms of Haplophragmoides ST-902-A, but can be distinguished from the latter by its generally larger size, the presence of at least one additional chamber in the ultimate whorl, and the radial sutures. In addition, H. ST-902-A is often found in a pyritized state, a condition not observed in H. G45-4-55-A.

Haplophragmoides S47-35-6-A

Plate III, Fig. 3.

Test planispiral, periphery rounded, somewhat lobulate, with a thin transparent border; test partly evolute on one side, with part of preceding whorl visible, opposite side much more evolute with nearly two complete whorls showing; chambers enlarging rather gradually, last one the largest, six in ultimate whorl, five in penultimate whorl on more evolute side; sutures distinct, depressed, curved; wall very finely arenaceous, with much cement, giving a smooth exterior finish; aperture, a low arch at the base of the terminal face, placed slightly to the evolute side of the test.

Diameter of holotype: - .32 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality S47-35 in Tp. 78, Rge. 17- W 6th Meridian, on the west bank of the Kiskatinaw River, one mile downstream from Arras, British Columbia, at a footage of 6 above the "white chalcedonic bed", or 151 feet above the top of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - At the Kiskatinaw River localities of S47-36 and S47-35, this species occurs over an interval from 17 feet below the "white chalcedonic bed" to 12 feet above it, with most of the specimens being found at a footage of 6 above this bed. Only two specimens are found at the Henderson Creek localities of G45-4 and G45-3, at footages of 35 below and 75 above the "white chalcedonic bed", respectively.

Comparison: - This species is identical to Haplophragmoides 35-6-B of Stelck, from the same locality and footage. In his remarks, Stelck (1950, p. 131) commented on the similarity of this form to Trochammina, "this species with unequal involution is suggestive of Trochammina but inasmuch as the aperture is on the more evolute side it may be left in the genus Haplophragmoides".

Haplophragmoides G45-3-80-A

Plate III, Fig. 2.

Test planispiral, evolute, with umbilicus exposing about two and one-half whorls on both sides of test; test compressed, periphery rounded; chambers, of approximately equal size, about ten and one-half in both ultimate and penultimate whorls; sutures distinct, slightly depressed, thickened, strongly arcuate; wall finely arenaceous, with much cement giving a smooth external finish; aperture, a low slit at the base of the ultimate chamber.

Diameter of holotype .31 mm.; thickness .08 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-3 in Lsd. 12, Sec. 15, Tp. 79, Rge. 13- W 6th Meridian, on Henderson Creek, Alberta, at a footage of 80 above the "white chalcedonic bed" or about 280 feet above the projected top of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This species has not been observed outside of the western part of the report area, where it occurs in the central portion of

the Kaskapau formation, above the Pouce Coupe sand. At the Kiskatinaw River localities of S47-36 and S47-35, some specimens occur between the footages of 50 below and 6 above the "white chalcedonic bed". The form ranges at the Henderson Creek localities of G45-4 and G45-3 over an interval from 40 feet below the "white chalcedonic bed" to 150 above it (the top of the sampled section).

Comparison: - This form probably stands in varietal relationship to Haplophragmoides G46-1-10-A, differing from the latter in having an additional two chambers, and in being much compressed, the compression possibly accounting for its arcuate sutures.

H. G45-3-80-A is very similar to H. G45-3-90-A and it is quite possible that the former form is only a much compressed counterpart of the latter.

Haplophragmoides G45-3-90-A

Plate III, Fig. 1.

Test planispiral, completely evolute with umbilicus exposing about three and one-half whorls on both sides of test; periphery rounded, somewhat indented; chambers, of approximately equal size, somewhat inflated, subglobular, nine and one-half in ultimate whorl, six and one-half in penultimate whorl; sutures distinct, depressed, radial, except for last four in ultimate whorl, which are slightly curved; wall finely arenaceous, with much cement giving a smooth external finish; aperture, a low slit with notch at the base of the ultimate chamber.

Diameter of holotype .31 mm.; thickness .11 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-3 in Lsd. 12, Sec. 15, Tp. 79, Rge. 13- W 6th Meridian on Henderson Creek, Alberta, at a footage of 90 above the "white chalcedonic bed" or about 290 feet above the projected top of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This form has been recognized only in the western part of the report area, where it occurs in the central portion of the Kaskapau formation, above the Pouce Coupe sand. At the Henderson Creek localities of G45-4 and G45-3, the form ranges over an interval from 50 feet below the "white chalcedonic bed" to 95 feet above it (150 to 295 feet above the projected top of the Pouce Coupe sand). At the Kiskatinaw River locality of S47-36, some specimens occur in the interval 6 to 50 feet below the "white chalcedonic bed".

Comparison: - This form probably stands in varietal relationship to Haplophragmoides G46-1-10-A, differing from the latter only in being more evolute, in having subglobular chambers, and in apparently having one more whorl of chambers. In cases where there has been much compression, or where preservation is poor, these two forms cannot readily be distinguished.

H. G45-3-90-A is also very similar to H. G45-3-80-A and further work on these forms might very well show the latter to be merely a much compressed counterpart of the former.

Haplophragmoides G45-3-145-B

Plate III, Fig. 10.

Test planispiral, almost involute, with only small portion of preceding whorl visible, periphery rounded; chambers, of approximately equal size, very slightly inflated, six and one-half to seven in ultimate whorl; sutures distinct, depressed, all radial save ultimate one, which is slightly curved; wall finely arenaceous with much cement giving a smooth finish to the exterior; aperture, a low rounded arched opening at the base of the terminal face.

Diameter of holotype .22 mm.; thickness .09 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-3 in Lsd. 12, Sec. 15, Tp. 79, Rge. 13- W 6th Meridian on Henderson Creek, Alberta, at a footage of 145 above the "white chalcedonic bed" or 345 feet above the projected top of the Pouce Coupe sand.

Holotype : - University of Alberta Paleontological Type Collection.

Range: - Most specimens of this species occur near the top of the sampled section at the Henderson Creek locality of G45-3, that is, in the interval 140 to 150 feet above the "white chalcedonic bed" (340 to 350 feet above the projected top of the Pouce Coupe sand). However, several specimens were recovered at the Kiskatinaw River locality of S47-36 from a footage of 74 below the "white chalcedonic bed" (70 feet above the Pouce Coupe sand).

Comparison: - This species is rather similar to Haplophragmoides

G46-1-10-A in having radial sutures and the same type of arenaceous wall. However, the latter form has at least one and one-half chambers more in its ultimate whorl and is more evolute than H. G45-3-145-B.

Genus PROTEONINA Williamson, 1858

Proteonina SR-1034-A

Plate I, Fig, 5, 6.

Test flattened, a single chamber, roughly bottle shaped, with central area much depressed (through crushing); neck prominent, but much thinner than main part of test; maximum diameter occurring about midway between base of neck and opposite end of test; wall coarsely arenaceous, of grains up to .1 mm., held in place by a small amount of cement; aperture terminal, an elliptical slit, occupying nearly all of the area at the end of the neck.

Length of holotype (Fig. 6) .42 mm.; maximum diameter .22 mm.; length of neck .09 mm.

Length of paratype (Fig. 5) .3 mm.; maximum diameter .18 mm.; length of neck .04 mm.

Holotype locality: - Imperial Oil Limited Spirit River #1 Well in Lsd. 12, Sec. 20, Tp. 78, Rge. 6- W 6th Meridian, Alberta, at a depth of 1034 feet, 75 feet above the base of the Kaskapau formation.

Paratype locality: - as above, at a depth of 1036 feet, 73 feet above the base of the Kaskapau.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, this species reaches its acme in the Ammobaculites ST-930-A zone of the basal Kaskapau, at a footage of 75 above the base of the formation, and rarely, if ever, occurs above the zone. It has not been positively identified outside of the Spirit River Area.

Genus SPIROPLECTAMMINA Cushman, 1927

Spiroplectammina ST-838-B

Plate II, Fig. 38, 39.

Test somewhat compressed, generally found as a pyritized or partially pyritized replacement, early portion of six chambers, planispiral, comprising one-quarter to one-third of length of test, becoming biserial while still spiral; later portion biserial, of eight interlocking chambers; sutures distinct, slightly depressed, radial in coiled portion, almost at right angles to the axis of the test in biserial portion, except for the final two which are noticeably oblique; wall finely arenaceous, considerable amount of cement giving a smooth finish to the exterior; aperture simple, terminal, at the distal end of the ultimate chamber.

Length of holotype (Fig. 39) .34 mm.; width of coiled portion .15 mm.; length of coiled portion .1 mm.

Length of paratype (Fig. 38) .3 mm.; width of coiled portion .13 mm.; length of coiled portion .1 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 838 feet, 4 feet above the top of the Pouce

Coupe sand equivalent.

Paratype locality: - Imperial Oil Limited Surface Division locality G45-19 in Lsd. 8, Sec. 4, Tp. 80, Rge. 13- W 6th Meridian, on the east bank of the Pouce Coupe River, Alberta, in a sample taken from 0 to 5 feet above the Pouce Coupe sand.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, the acme of this species occurs at a footage of 4 above the Pouce Coupe sand equivalent, with some specimens being recorded in the upper beds of the underlying Gaudryina ST-876-A zone of the lower Kaskapau. Maximum development occurs at the Pouce Coupe River locality of G45-19 directly above the Pouce Coupe sand, with no specimens being found outside of the 15 feet of section above this bed.

Remarks: - It is with some doubt that this species, with its terminal aperture, is referred to the genus Spiroplectammina, which has its aperture at the base of the last chamber. Possibly, it might be more accurately classified under the genus Ammobaculoides, which possesses a terminal aperture, but also has a definite uniserial portion, which in turn, is lacking in this species. This form can probably be regarded as an intermediate stage between the two genera.

Genus TEXTULARIA Defrance, 1824

Textularia G45-5-220-A

Plate II, Fig. 34, 35.

Test of medium size, often preserved as a pyrite replacement, tapering, compressed, slightly twisted in early portion; chambers, twelve in interlocking biserial arrangement, enlarging rather gradually, with ultimate chamber the largest, and the last four comprising over half of length of test; sutures distinct, depressed, wall finely arenaceous with much cement, giving a smooth finish to the exterior; aperture, a notch at the inner margin of the ultimate chamber, extending well up on to the terminal face.

Length of holotype (Fig. 34) .41 mm.; maximum width .18 mm.

Length of paratype (Fig. 35) .39 mm.; maximum width .15 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta, at a footage of 220 below the base of the Pouce Coupe sand.

Paratype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 896 feet, 159 feet above the projected base of the Kaskapau formation.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This species appears to occur sporadically over most of the Kaskapau section studied, but generally it is indicative of

the lower portion. At Spirit River, specimens were recovered from two short intervals in the basal part of the Kaskapau, the lower of these being between the footages of 59 and 61 above the base of the formation, with the upper one between the footage of 150 and 163 above the base. At the Doe Creek localities of G45-5 and S47-4, a few specimens were found in the lower 90 feet of the Kaskapau. Much higher in the section, at the Kiskatinaw River localities of S47-36 and S47-35, one form was recovered from the former locality at a footage of 74 below the "white chalcedonic bed" (70 feet above the Pouce Coupe sand), while the latter locality yielded a specimen from a footage of 12 above the "chalcedonic bed".

Comparison: - This species is identical to Textularia 36-74-A of Stelck from the Kiskatinaw River locality of S47-36. Stelck (1950, p. 162) noted a similarity to an outside species, "This small Textularia is somewhat like Textularia pygmaea Reuss from the upper Gault but is more twisted than the latter species".

Textularia ST-747-B

Plate II, Fig. 36.

Test minute, tapering, compressed, earliest portion of test sometimes slightly twisted, found only as a pyrite replacement and very fragile; chambers, twenty in biserial arrangement, first three pairs very small and barely visible, last seven pairs slightly larger and of approximately equal size; sutures fairly distinct, depressed; wall finely arenaceous with considerable amount of cement; aperture thought to be a notch at the base of the ultimate chamber.

Length of holotype .22 mm.; maximum width .06 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 747.5 feet, 15.5 feet above the top of the "Spirit River" sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This tiny form has not been recognized outside of the Spirit River Area, where it occurs over a short interval from 7 to 15.5 feet above the top of "Spirit River" sand in the Ammobaculites ST-747-A zone of the lower central Kaskapau.

Genus TRITAXIA Reuss, 1860

Tritaxia ST-664-B

Plate III, Fig. 12, 13, 14.

Test subtriangular in cross-section, tapering, compressed; test triserial, consisting of five whorls of three chambers each; chambers gradually enlarging in size; sutures, usually distinct, depressed; wall finely arenaceous with much cement, giving a rather glistening surface to many specimens; aperture circular, produced at the end of the ultimate chamber. Color usually white, occasionally light brown or brownish-white.

Length of holotype (Fig. 12) .28 mm.; maximum width .12 mm.

Length of paratype (Fig. 13) .26 mm.; maximum width .13 mm.

Length of paratype (Fig. 14) .28 mm.; maximum width .17 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 664 feet, 178 feet above the top of the Pouce Coupe sand equivalent.

Paratype (Fig. 13) locality: - as above, same depth.

Paratype (Fig. 14) locality: - as above, at a depth of 630 feet, 212 feet above the top of the Pouce Coupe sand equivalent.

Holotype and Paratypes: - University of Alberta Paleontological Type Collection.

Range: - This species seems to range over most of the Kaskapau section studied, but it occurs much more commonly in the Haplophragmoides ST-664-A zone of the central Kaskapau than elsewhere. At Spirit River, most of the specimens were found in this zone, with

only a relatively few being recovered from beds of the underlying microfaunal zones. At the Henderson Creek localities of G45-3 and G45-4, it was observed to occur sporadically in beds of the central Kaskapau, both above and below the "white chalcedonic bed". At the Pouce Coupe River locality of G45-6, some specimens were found at a footage of 15 above the Pouce Coupe sand. The only recorded occurrence of this species from beds below the Pouce Coupe sand, in the western part of the report area, was at the Doe Creek locality of S47-4, with one specimen being recovered from this section.

Remarks: - The triseriality of this species is generally not apparent from an examination of the vast majority of specimens. It is usually compressed in such a manner as to disguise both its triangularity and triseriality, since it appears upon preliminary examination, as a flattened, biserial form. Distortion in fossilization in some cases produces rather weird shapes of the test, making positive identification of this species difficult.

Tritaxia ST-618-A

Plate III, Fig. 15.

Test elongate, compressed, triserial, with about seven whorls of three chambers apiece; chambers gradually enlarging in size, those in last four whorls approximately equal; sutures indistinct, depressed; wall finely arenaceous, with grains no larger than .015 mm., moderate amount of cement; aperture circular, produced, at the end of the last chamber; color light brown or brownish-white.

Length of holotype .59 mm.; maximum width .18 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 618 feet, 224 feet above the top of the Pouce Coupe sand equivalent.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This form is confined to a 30 foot interval, 143 to 173 feet above the "Spirit River" sand, at the top of the Haplophragmoides ST-664-A zone of the central Kaskapau. It has been found only at Spirit River.

Comparison: - Tritaxia ST-618-A is probably an elongate variety of T. ST-664-B. Its biserial appearance is thought to be due to distortion in fossilization, and the form is considered to have been triserial originally.

Genus TROCHAMMINA Parker and Jones, 1859

Trochammina S47-4-186-A

Plate I, Fig. 14.

Test small, periphery rounded; test trochoid with a very low spire, of two and one-half whorls, eight chambers in ultimate whorl, about six in penultimate whorl; chambers, gradually enlarging, only those of the last whorl visible on the ventral side, which is umbilicate; sutures distinct, somewhat thickened, depressed, curved on the dorsal side, radial on the umbilical side; wall finely arenaceous, with much cement, giving a smooth finish to the exterior; aperture

not definitely recognizable, thought to be a low opening on the ventral side between the periphery and the umbilicus.

Diameter of holotype .15 mm.; thickness .04 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality S47-4 in Tp. 81, Rge. 13- W 6th Meridian at Doe Creek canyon, east of Doe River P.O., British Columbia, from a footage of 186 below the base of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - With one exception, this species is restricted to the pre-Pouce Coupe beds of the Kaskapau. At the Doe Creek localities of G45-5 and S47-4, the acme occurs at a footage of 82 above the base of the Kaskapau. The species is not a common one in the Spirit River section, where it appears to be confined to the Ammobaculites ST-930-A zone of the basal Kaskapau. The one exception, that is, the occurrence above the Pouce Coupe sand, was noted at the Pouce Coupe River locality of G45-6, in a bed 15 to 20 feet above the Pouce Coupe sand.

Comparison: - This species is identical to Trochammina 4-172-B of Stelck from the same locality, with a distance of only 14 feet between the elevations at which Stelck's hypotype and the writer's holotype were collected.

Upon a rough examination, this form appears to be almost the same as T. ST-956-C, but the latter form has less chambers in its ultimate whorl, and lacks the thickened, curved, dorsal sutures of T.S47-4-186-A.

Furthermore, the chambers in this species are considerably smaller than the ones in T. ST-956-C.

Trochammina ST-956-C

Plate I, Fig. 11, 12.

Test small, periphery rounded; test trochoid, with a low spire, of three whorls with six and one-half chambers in ultimate whorl, seven and one-half chambers in penultimate whorl, and about five in primary whorl; ventral side of test rather umbilicate; sutures distinct, depressed, slightly curved, nearly radial on dorsal side, radial on ventral side; wall generally finely arenaceous, but with a rare grain as large as .03 mm., considerable amount of cement, giving a smooth exterior finish to most specimens, more noticeable in outcrop forms; aperture, a low opening at the base of the ultimate chamber on the ventral side, lying about midway between the periphery and the umbilicus.

Diameter of holotype (Fig. 11) .2 mm.; thickness .11 mm.

Diameter of paratype (Fig. 12) .2 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 956 feet, 99 feet above the projected base of the Kaskapau formation.

Paratype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta, at a footage of 105 below the base of the Pouce Coupe sand.

Range: - This species is confined to the pre-Pouce Coupe beds at all localities. At Spirit River, it occurs commonly over the interval, extending from the base of the Kaskapau to a footage of 105 above it, and less commonly in the overlying beds of the Gaudryina ST-876-A zone to a point 170 feet above the Kaskapau base. It is present at the Pouce Coupe River locality of G45-18 and at the Doe Creek localities of G45-5 and S47-4 over an interval, extending from the Dunvegan-Kaskapau contact upwards to within 55 feet of the base of the Pouce Coupe sand. At the Dunvegan locality of C47-9, a concentration of specimens was recovered in a sample taken at a footage of 95 above the base of the Kaskapau.

Comparison: - This species is identical to Trochammina 4-249-A of Stelck from the Doe Creek locality of S47-4 at a footage of 249 below the base of the Pouce Coupe sand. The writer's views are in accord with those of Stelck (1950, p. 169), whose opinion is that this form is similar to the early stages of T. ST-892-A (T. 4-134-B of Stelck), and is probably ancestral to the latter. In compiling the detailed microfaunal log of Spirit River, the writer concedes that some of the specimens referred to this species are probably young forms of T. ST-892-A.

This species is superficially similar to T. S47-4-186-A, but has fewer and larger chambers than the latter form, and differs from it also in having radial or nearly radial dorsal sutures, as opposed to the curved ones of T. S47-4-186-A.

Trochammina ST-892-A

Plate I, Fig. 15, 16.

Test of medium size, periphery angular to broadly rounded; test trochoid, with an intermediate-size spire, sombrero-shaped in periphery view, with first three whorls representing the crown, and final whorl the brim; chambers indistinct, usually distorted, about six in ultimate whorl, six in penultimate whorl, and six in antepenultimate whorl; sutures often indistinct, appearing slightly curved; wall finely arenaceous with much cement giving a smooth exterior finish; aperture not positively observed, assumed to be a low opening on the ventral side between the periphery and umbilicus.

Diameter of holotype (Fig. 15) .33 mm.; thickness through spire .14 mm.

Diameter of paratype (Fig. 16) .3 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 892 feet, 163 feet above the projected base of the Kaskapau formation.

Paratype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta, at a footage of 50 below the base of the Pouce Coupe sand.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This species occurs in close association with Trochammina ST-956-C and is found over approximately the same lower

Kaskapau intervals, at the Doe Creek localities of G45-5 and S47-4, and at the Pouce Coupe River locality of G45-19. It is present in the Spirit River section, but was not recovered at the Dunvegan locality of C47-9. T. ST-892-A is not nearly so common a form as T. ST-956-C.

Comparison: - This species is identical to Trochammina 4-134-B of Stelck from locality S47-4 at a footage of 134 below the base of the Pouce Coupe sand. T. ST-892-A appears to be descended from T. ST-956-C (T. 4-249-A of Stelck).

Trochammina ST-910-A

Plate II, Fig. 1, 2, 3.

Test exhibiting considerable variation in size and method of preservation, often found as a partial pyrite replacement, but non-pyritized, crushed, pentagonal forms also common, periphery lobulate; test trochoid with a low spire (holotype, Fig. 2 has the highest spire in any of the specimens found), of four whorls, with five chambers visible in each of the last three whorls; ventral side, with a well-developed umbilicus; chambers enlarging gradually, globular in outline; sutures distinct in all but badly crushed forms, depressed, curved on dorsal side, radial on ventral side; wall finely arenaceous for most part, with an occasional grain as large as .03 mm., but usually less than half of this size, and with a considerable amount of cementing material, giving a smooth overall finish; aperture not observed, assumed to be a low opening on the ventral side between the periphery and umbilicus, probably extending into the latter. Color light brownish-white in non-pyritized forms.

Diameter of holotype (Fig. 2) .27 mm.; thickness through spire .15 mm.

Diameter of paratype (Fig. 1) .39 mm.; thickness through spire .13 mm.

Diameter of paratype (Fig. 3) .22 mm.

Holotype (Fig. 2) locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7-W 6th Meridian, Alberta, at a depth of 910 feet, 145 feet above the projected base of the Kaskapau formation.

Paratype (Fig. 1) locality: - as above, at a depth of 812 feet, 30 feet above the top of the Pouce Coupe sand equivalent.

Paratype (Fig. 3) locality: - as above, at a depth of 878 feet, 177 feet above the projected base of the Kaskapau formation.

Holotype and Paratypes: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, this species occurs erratically in a subzone, bearing its name, of the Gaudryina ST-876-A zone of the lower Kaskapau, numerous specimens being found at the base of the subzone and again, 5 feet from its top. It is not commonly found above the Pouce Coupe sand equivalent. A concentration of specimens was recovered at the Dunvegan locality of C47-9 at a footage of 125 above the base of the Kaskapau. This species has not been recognized in the Pouce Coupe Area.

Comparison: - This species is very closely related to Trochammina ST-812-A, but has one more whorl of chambers than the latter form, and generally is somewhat larger in size.

Again, this species is similar to Trochammina albertensis Wickenden from the Bearpaw shale of Southern Alberta in being approximately the same size, in having the same number of whorls and chambers, and in having identical sutures. However, T. ST-910-A lacks the relatively high spiral development of T. albertensis, and appears to have coarser grains in its wall structure.

Trochammina ST-812-A

Plate II, Fig. 6.

Test usually small, occasionally medium sized, generally partially pyritized, periphery lobulate; test trochoid with a low spire, of three whorls, five chambers in both ultimate and penultimate whorls, three in primary whorl; chambers enlarging gradually, globular in outline; ventral side with a well-developed umbilicus; sutures distinct, depressed, slightly curved on dorsal side, radial on ventral side; wall arenaceous, with quartz grains usually no larger than .025 mm., cemented with a moderate amount of finely arenaceous material, giving a rather smooth overall finish to exterior; aperture not observed, assumed to be a low opening on the ventral side between the periphery and the umbilicus, probably extending into the latter.

Diameter of holotype .24 mm.; thickness .15 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 812 feet, 30 feet above the top of the Pouce Coupe sand equivalent.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - At Spirit River, this species is confined to the Ammobaculites ST-747-A zone of the lower central Kaskapau, occurring mainly in the interval 215 to 255 feet above the base of the Kaskapau. The form occurs very rarely elsewhere, with one specimen being found at the Dunvegan locality of C47-9, from a footage of 135 above the base of the Kaskapau. At the Doe Creek locality of G45-5, one specimen was identified below the Pouce Coupe sand at a footage of 180 above the base of the Kaskapau.

Comparison: - This species is very closely related to T. ST-910-A, but has one less whorl of chambers than the latter form, and generally is somewhat smaller in size. However, in many cases, both of these species are badly compressed and distorted in fossilization, making it impossible to count the whorls, and thus casting much doubt on any specific identifications attempted.

Trochammina ST-658-A

Plate III, Fig. 11.

Test of fair size, compressed, flattened, periphery lobulate; test trochoid with a very low spire, of three whorls, six to seven chambers in ultimate whorl, same number in penultimate whorl, and about five in primary whorl; ventral side often with a ring-like ridge surrounding the umbilicus, created by compression of the chambers on fossilization; chambers gradually enlarging in size, subglobular in outline, often scalloped on ventral side; sutures rather

indistinct, oblique, depressed on dorsal side, radial, and with their location usually indicated by ridges on the ventral side; wall mostly finely arenaceous, but often with flecks of dark mica up to .04 mm. in size, scattered over the dorsal side, concentrated for the most part in the region of the spire; amount of cement considerable, giving a fairly smooth finish to the exterior; aperture not recognized, assumed to be a low opening on the ventral side between the periphery and the umbilicus.

Diameter of holotype .38 mm.; thickness .05 mm.

Holotype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 658 feet, 184 feet above the top of the Pouce Coupe sand equivalent.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This species occurs commonly in the Haplophragmoides ST-664-A zone of the central part of the Kaskapau at Spirit River, over a 50 foot interval (T. ST-658-A subzone), extending from 63 to 113 feet above the top of the "Spirit River" sand. In the western part of the report area, at the Henderson Creek locality of G45-3, about ten specimens were found in the uppermost part of the sampled section, that is, 135 to 150 feet above the "white chalcedonic bed" (approximately 335 to 350 feet above the projected top of the Pouce Coupe sand).

Comparison: - This species does not seem to differ a great deal from Trochammina diagonis (Carsey) Cushman and Waters, described originally from the Upper Cretaceous Navarro group of Texas. The Alberta

form appears to have an extra whorl of chambers and its sutures are not as distinct as those of the Texas species.

Genus VERNEUILINA d'Orbigny, 1840

Verneuilina SR-1009-A

Plate II, Fig. 40, 41.

Test small to medium in size, tapering, subtriangular in cross-section, often found as a pyrite replacement, and generally considerably flattened by compression; test triserial throughout, composed of five volutions of three chambers each; maximum width near apertural end, chambers increasing rather rapidly in size as added, with final volution comprising at least one-third of the length of the test; sutures distinct, depressed; wall finely arenaceous with much cement, giving a smooth exterior finish; aperture a broadly arched opening at the base of the ultimate chamber.

Length of holotype (Fig. 40) .38 mm.; maximum width .18 mm.

Length of paratype (Fig. 41) .43 mm.; maximum width .18 mm.

Holotype locality: - Imperial Oil Limited Spirit River #1 Well in Lsd. 12, Sec. 20, Tp. 78, Rge. 6- W 6th Meridian, Alberta, at a depth of 1009 feet, 100 feet above the base of the Kaskapau formation.

Paratype locality: - Imperial Oil Limited Spirit River Structure Test #A-337-1 in Lsd. 16, Sec. 24, Tp. 78, Rge. 7- W 6th Meridian, Alberta, at a depth of 916 feet, 139 feet above the projected base of the Kaskapau.

Holotype and Paratype: - University of Alberta Paleontological Type Collection.

Range: - This species is confined to the pre-Pouce Coupe beds at all localities. At Spirit River, it occurs fairly commonly over a 150 foot interval, from 45 to 195 feet above the base of the Kaskapau. At the Dunvegan locality of C47-9, a fair number of specimens were recovered over an interval from 115 to 135 feet (top of the sampled section) above the base of the Kaskapau. It occurs in the pre-Pouce Coupe microfaunal zones at the Doe Creek localities of G45-5 and S47-4, but is not so common here as in the Spirit River Area.

Comparison: - This species is identical to Verneuilina 3-165-A of Stelck from the Doe Creek locality of S47-3, 165 feet below the Pouce Coupe sand. It is closely related to V. G45-5-110-C (V. 4-134-A of Stelck), but is much more robust and has larger chambers than the latter form.

Stelck noted a similarity between this species and the young forms of Verneuilina perplexa Loeblich from the Cenomanian of Texas. According to Stelck (1950, p. 181), the only difference between the two is the larger size of the Canadian species.

Verneuilina G45-5-110-C

Plate II, Fig. 37.

Test small, slender, tapering, subtriangular in cross-section; test triserial, composed of five convolutions of three chambers each; maximum width at penultimate convolution; chambers gradually enlarging in size; sutures distinct, depressed; wall finely arenaceous, grains averaging about .015 mm., with much cement giving a smooth finish to the exterior; aperture not positively recognized, but believed to be

a broadly arched opening at the inner margin of the ultimate chamber.

Length of holotype .29 mm.; maximum width .12 mm.

Holotype locality: - Imperial Oil Limited Surface Division locality G45-5 in Lsd. 13, Sec. 10, Tp. 81, Rge. 13- W 6th Meridian, on Doe Creek, Alberta, at a footage of 110 below the base of the Pouce Coupe sand.

Holotype: - University of Alberta Paleontological Type Collection.

Range: - This species is restricted to the pre-Pouce Coupe beds in both the Spirit River and Doe Creek sections. At the former locality, maximum development appears to occur at a footage of 105 above the base of the Kaskapau, while at the latter locality, it seems to be at a footage of 145 above the base. Furthermore, at Doe Creek, the form apparently does not occur above the Ammobaculites ST-930-A zone.

Comparison: - This species is identical to Verneuilina 4-134-A of Stelck from the Doe Creek locality of S47-4 at a footage of 134 below the base of the Pouce Coupe sand. It is closely related to V. SR-1009-A (V. 3-165-A of Stelck), but is much more slender and has smaller chambers than the latter form. Quoting from Stelck's remarks, (1950, p. 182) "It is probably a dwarf variety of the latter species".

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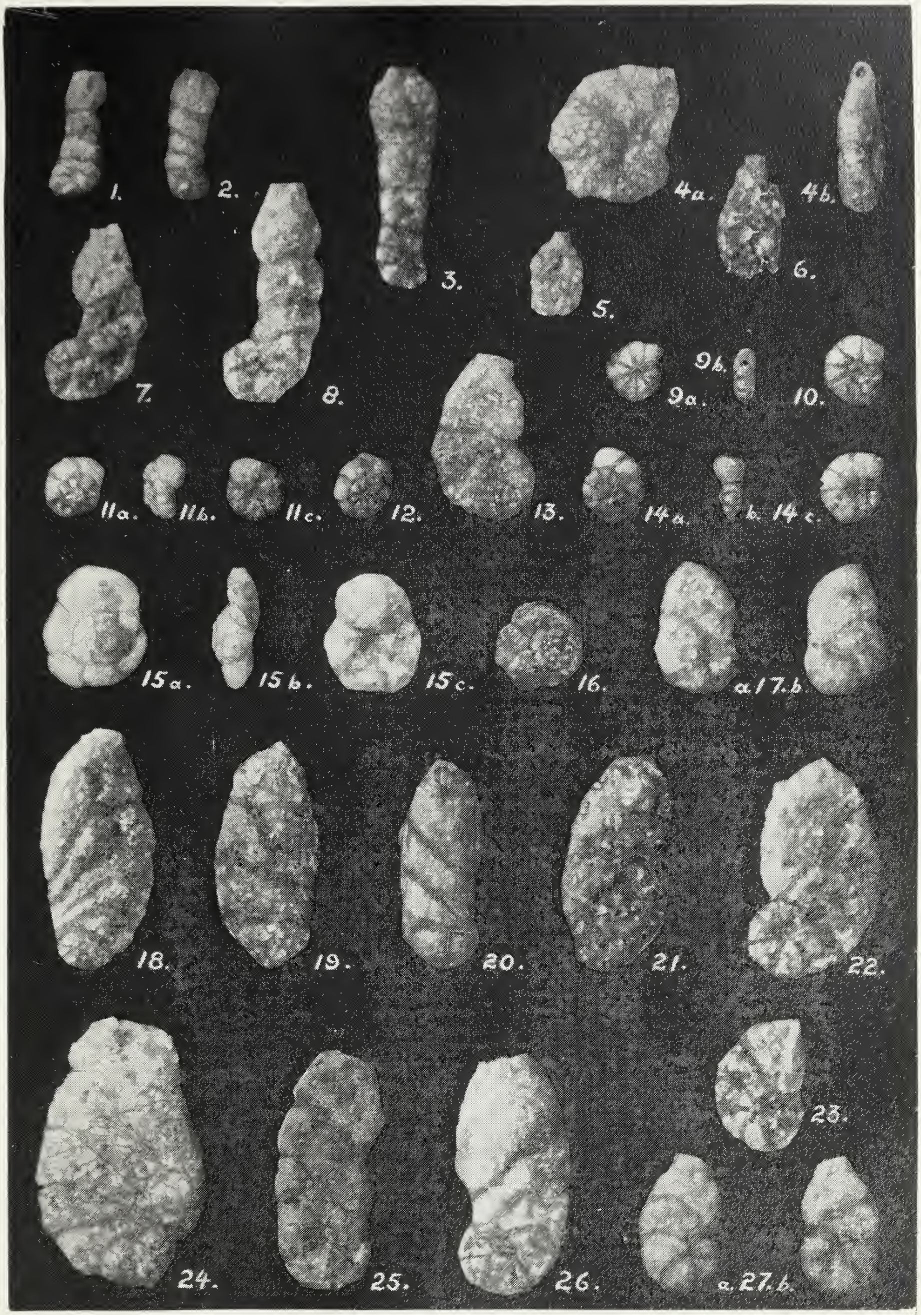
PLATE I

UPPER CENOMANIAN FORAMINIFERA

LOWER PART OF KASKAPAU FORMATION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9a.
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a.27.b.

Explanation of Plate I

Fig. 1, 2, 3: Ammobaculites ST-930-A, X45. Fig. 1, holotype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 930 feet, 125 feet above the base of the Kaskapau; slightly retouched photograph of side view of holotype. Fig. 2, paratype, from lower part of Kaskapau formation, 165 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of side view of paratype. Fig. 3, paratype, from same locality as holotype, at a depth of 937.5 feet, 117.5 feet above the base of the Kaskapau; slightly retouched photograph of an elongate paratype.

Fig. 4: Ammobaculites G45-5-110-A, X45, holotype, from lower part of Kaskapau formation, 110 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; a, slightly retouched photograph of side view of holotype; b, slightly retouched photograph of apertural view of holotype.

Fig. 5, 6: Proteonina SR-1034-A, X45. Fig. 5, paratype, from lower part of Kaskapau formation, Imperial Spirit River #1 Well, at a depth of 1036 feet, 73 feet above the base of the Kaskapau; slightly retouched photograph of paratype. Fig. 6, holotype, from same locality at a depth of 1034 feet, 75 feet above the base of the Kaskapau; slightly retouched photograph of holotype.

Fig. 7, 8: Ammomarginulina ST-956-A, X45. Fig. 7, holotype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 956 feet, 99 feet above the base of the Kaskapau; slightly retouched photograph of holotype. Fig. 8, paratype, from lower part of Kaskapau formation, Imperial Spirit River #1 Well, at a depth of 1062 feet, 47 feet above the base of the Kaskapau; slightly retouched photograph of paratype.

Fig. 9, 10: Haplophragmoides ST-958-A, X60. Fig. 9, holotype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 958 feet, 97 feet above the base of the Kaskapau; 9a, slightly retouched photograph of side view of holotype; 9b, drawing of peripheral view of holotype. Fig. 10, paratype, from lower part of Kaskapau formation, 110 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of paratype.

Fig. 11, 12: Trochammina ST-956-C, X45. Fig. 11, holotype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 956 feet, 99 feet above the base of the Kaskapau; 11a, slightly retouched photograph of dorsal view of holotype; 11b, slightly retouched photograph of peripheral view of holotype; 11c, slightly retouched photograph of ventral view of holotype. Fig. 12, paratype, from lower part of Kaskapau formation, 105 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of dorsal view of paratype.

Fig. 13: Ammomarginulina ST-956-B, X45, holotype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 956 feet, 99 feet above the base of the Kaskapau; slightly retouched photograph of holotype.

Fig. 14: Trochammina S47-4-186-A, X60, holotype, from lower part of Kaskapau formation, 186 feet below the base of the Pouce Coupe sand, locality S47-4, Doe Creek, Alberta; 11a, slightly retouched photograph of dorsal view of holotype; 11b, drawing of peripheral view of holotype; 11c, slightly retouched photograph of ventral view of holotype.

Fig. 15, 16: Trochammina ST-892-A, X45, Fig. 15, holotype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 892 feet, 163 feet above the base of the Kaskapau; 15a, slightly retouched photograph of dorsal view of holotype; 15b, slightly retouched photograph of peripheral view of holotype; 15c, slightly retouched photograph of ventral view of holotype. Fig. 16, paratype, from lower part of Kaskapau formation, 50 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of dorsal view of paratype.

Fig. 17: Flabellammina G45-5-105-B, X45, holotype, from lower part of Kaskapau formation, 105 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; a, slightly retouched photograph of partly evolute side view of holotype; b, slightly retouched photograph of involute side view of holotype.

Fig. 18, 19: Flabellammina SR-1011-A, X45. Fig. 18, holotype, from lower part of Kaskapau formation, Imperial Spirit River #1 Well, at a depth of 1011 feet, 98 feet above the base of the Kaskapau; slightly retouched photograph of side view of holotype. Fig. 19, paratype, from same locality, at a depth of 1013 feet; slightly retouched photograph of side view of paratype.

Fig. 20: Flabellammina G45-5-110-B, X45, holotype, from lower part of Kaskapau formation, 110 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of side view of holotype.

Fig. 21: Flabellammina G45-5-115-A, X45, holotype, from lower part of Kaskapau formation, 115 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of side view of holotype.

Fig. 22, 23: Flabellammina SR-1013-A, X45. Fig. 22, holotype, from lower part of Kaskapau formation, Imperial Spirit River #1 Well, at a depth of 1013 feet, 96 feet above the base of the Kaskapau; slightly retouched photograph of side view of holotype. Fig. 23, paratype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 937.5 feet, 117.5 feet above the base of the Kaskapau; slightly retouched photograph of side view of a young paratype.

Fig. 24: Flabellammina C47-9-95-A, X45, holotype, from lower part of Kaskapau formation, 95 feet above the base of the Kaskapau, locality C47-9, Dunvegan, Alberta; slightly retouched photograph of side view of holotype.

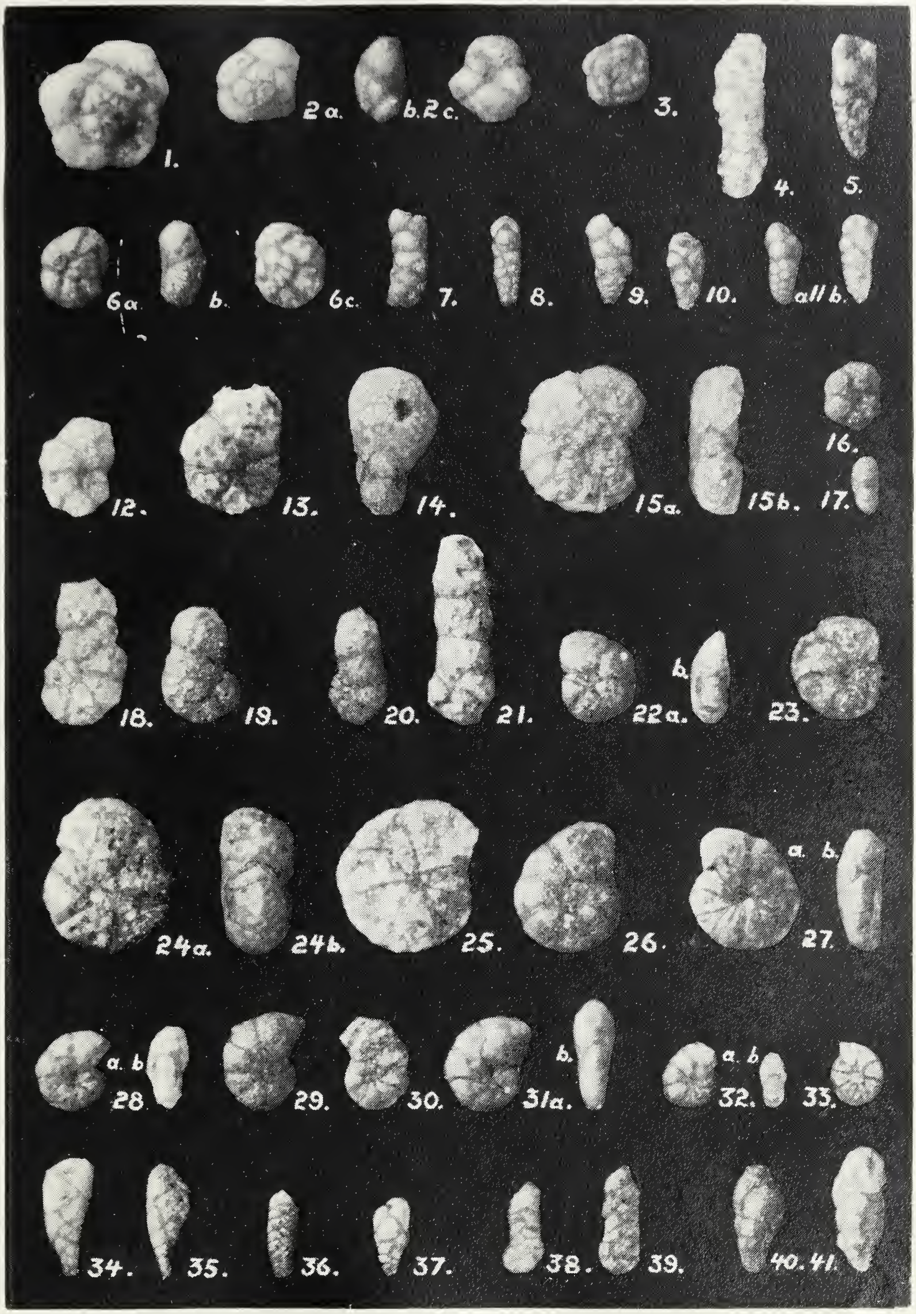
Fig. 25, 26: Flabellammina ST-937-A, X45. Fig. 25, holotype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 937 feet, 118 feet above the base of the Kaskapau; slightly retouched photograph of side view of holotype. Fig. 26, paratype, from lower part of Kaskapau formation, 105 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of side view of paratype, showing distorted ultimate chamber.

Fig. 27: Flabellammina G45-5-105-A, X45, holotype, from lower part of Kaskapau formation, 105 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; a, b, views of opposite sides of holotype.

PLATE II

UPPER CENOMANIAN FORAMINIFERA

LOWER AND CENTRAL PARTS OF KASKAPAU FORMATION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24 a.
24 b.
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a. b.
27.
a. b
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29.
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b.
31 a.
a. b
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40. 41.

Explanation of Plate II

Fig. 1, 2, 3: Trochammina ST-910-A, X45. Fig. 1, paratype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 812 feet, 30 feet above the top of the Pouce Coupe sand equivalent; slightly retouched photograph of dorsal view of crushed paratype. Fig. 2, holotype, from lower part of Kaskapau formation, same locality, at a depth of 910 feet, 145 feet above the base of the Kaskapau; 2a, slightly retouched photograph of dorsal view of holotype; 2b, slightly retouched photograph of peripheral view of holotype; 2c, slightly retouched photograph of ventral view of holotype. Fig. 3, paratype, from lower part of Kaskapau formation, same locality, at a depth of 878 feet, 24 feet below the base of the Pouce Coupe sand equivalent; slightly retouched photograph of paratype.

Fig. 4, 5: Gaudryina ST-876-A, X45. Fig. 4, holotype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 876 feet, 22 feet below the base of the Pouce Coupe sand equivalent; slightly retouched photograph of holotype. Fig. 5, paratype, from lower part of Kaskapau formation, 85 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of paratype (probable microspheric specimen)

Fig. 6: Trochammina ST-812-A, X45, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 812 feet, 30 feet above the top of the Pouce Coupe sand equivalent; a, slightly retouched photograph of ventral view of holotype; b, slightly retouched photograph of peripheral view of holotype; c, slightly retouched photograph of dorsal view of holotype.

Fig. 7: Dorothia ST-830-A, X45, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 830 feet, 12 feet above the top of the Pouce Coupe sand equivalent; slightly retouched photograph of holotype.

Fig. 8: Dorothia ST-834-A, X45, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 834 feet, 8 feet above the top of the Pouce Coupe sand equivalent; slightly retouched photograph of holotype.

Fig. 9, 10: Gaudryina SR-1018-A, X45. Fig. 9, holotype, from lower part of Kaskapau formation, Imperial Spirit River #1 Well, at a depth of 1018 feet, 91 feet above the base of the Kaskapau; slightly retouched photograph of holotype. Fig. 10, paratype, from lower part of Kaskapau formation, 115 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of paratype.

Fig. 11: Gumbelitria ST-782-A, X45, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1 at a depth of 782 feet, 7 feet below the base of the "Spirit River" sand; a, slightly retouched photograph of side view of holotype; b, slightly retouched photograph of apertural view of holotype.

Fig. 12, 13, 14: Ammobaculites G45-19-0-A, X45. Fig. 12, holotype from central part of Kaskapau formation, directly above the Pouce Coupe sand, locality G45-19, Pouce Coupe River, Alberta; slightly retouched photograph of side view of holotype. Fig. 13, paratype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 816 feet, 26 feet above the top of the Pouce Coupe sand equivalent; slightly retouched photograph of side view of paratype. Fig. 14, paratype, from same locality, at a depth of 747.5 feet, 15.5 feet above the top of the "Spirit River" sand; slightly retouched photograph of apertural view of large paratype.

Fig. 15: Haplophragmoides ST-740-A, X45, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 740 feet, 23 feet above the top of the "Spirit River" sand; a, slightly retouched photograph of side view of holotype; b, slightly retouched photograph of peripheral view of holotype.

Fig. 16, 17: Haplophragmoides SR-1018-B, X45. Fig. 16, holotype, from lower part of Kaskapau formation, Imperial Spirit River #1 Well, at a depth of 1018 feet, 91 feet above the base of the Kaskapau; slightly retouched photograph of side view of holotype. Fig. 17, paratype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 834 feet, 8 feet above the top of the Pouce Coupe sand equivalent; slightly retouched photograph of peripheral view of paratype.

Fig. 18, 19: Ammobaculites ST-745-A, X45, holotype and paratype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 745 feet, 18 feet above the top of the "Spirit River" sand; Fig. 18, slightly retouched photograph of side view of holotype; Fig. 19, slightly retouched photograph of side view of paratype.

Fig. 20, 21: Ammobaculites ST-747-A, X45. Fig. 20, paratype, from central part of Kaskapau formation, 55 feet below the "white chalcedonic bed", locality G45-4, Henderson Creek, Alberta; slightly retouched photograph of side view of young paratype. Fig. 21, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 747.5 feet, 15.5 feet above the top of the "Spirit River" sand; slightly retouched photograph of side view of holotype.

Fig. 22, 23: Haplophragmoides ST-902-A, X45. Fig. 22, holotype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 902.5 feet, 152.5 feet above the base of the Kaskapau; 22a, slightly retouched photograph of side view of holotype; 22b, slightly retouched photograph of peripheral view of holotype. Fig. 23, paratype, from same locality, at a depth of 898 feet, 157 feet above the base of the Kaskapau; slightly retouched photograph of side view of a nearly flattened paratype.

Fig. 24, 25, 26: Haplophragmoides ST-850-A, X45. Fig. 24, holotype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 850 feet, 8 feet below the top of the Pouce Coupe sand equivalent; 24a, slightly retouched photograph of side view of holotype; 24b, slightly retouched photograph of peripheral view of holotype. Fig. 25, paratype, from same locality, central part of Kaskapau formation, at a depth of 758 feet, 5 feet above the top of the "Spirit River" sand; slightly retouched photograph of side view of crushed paratype. Fig. 26, paratype, from same locality, central part of Kaskapau formation, at a depth of 754 feet; slightly retouched photograph of side view of a pyritized paratype, showing position of aperture.

Fig. 27: Haplophragmoides ST-664-A, X45, paratype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 760 feet, 3 feet above the top of the "Spirit River" sand; a, slightly retouched photograph of side view of paratype; b, slightly retouched photograph of peripheral view of paratype.

Fig. 28, 29: Haplophragmoides ST-838-A, X45. Fig. 28, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 838 feet, 4 feet above the top of the Pouce Coupe sand equivalent; 28a, slightly retouched photograph of side view of holotype; 28b, slightly retouched photograph of peripheral view of holotype. Fig. 29, paratype, from same locality, at a depth of 750 feet, 13 feet above the top of the "Spirit River" sand.

Fig. 30, 31: Haplophragmoides G45-5-85-A, X45. Fig. 30, holotype, from lower part of Kaskapau formation, 85 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of side view of holotype. Fig. 31, paratype, from same locality, 110 feet below the base of the Pouce Coupe sand; 31a, slightly retouched photograph of side view of paratype; 31b, slightly retouched photograph of peripheral view of paratype.

Fig. 32,33: Haplophragmoides SR-1011-B, X60. Fig. 32, holotype, from lower part of Kaskapau formation, Imperial Spirit River #1 Well, at a depth of 1011 feet, 98 feet above the base of the Kaskapau; 32a, slightly retouched photograph of side view of holotype; 32b, drawing of peripheral view of holotype. Fig. 33, paratype, from lower part of Kaskapau formation, 85 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of side view of paratype.

Fig. 34, 35: Textularia G45-5-220, X45. Fig. 34, holotype, from lower part of Kaskapau formation, 220 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of holotype. Fig. 35, paratype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 896 feet, 159 feet above the base of the Kaskapau; slightly retouched photograph of paratype.

Fig. 36: Textularia ST-747-B, X60, holotype from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 747.5 feet, 15.5 feet above the top of the "Spirit River" sand; slightly retouched photograph of holotype.

Fig. 37: Verneuilina G45-5-110-C, X45, holotype, from lower part of Kaskapau formation, 110 feet below the base of the Pouce Coupe sand, locality G45-5, Doe Creek, Alberta; slightly retouched photograph of holotype.

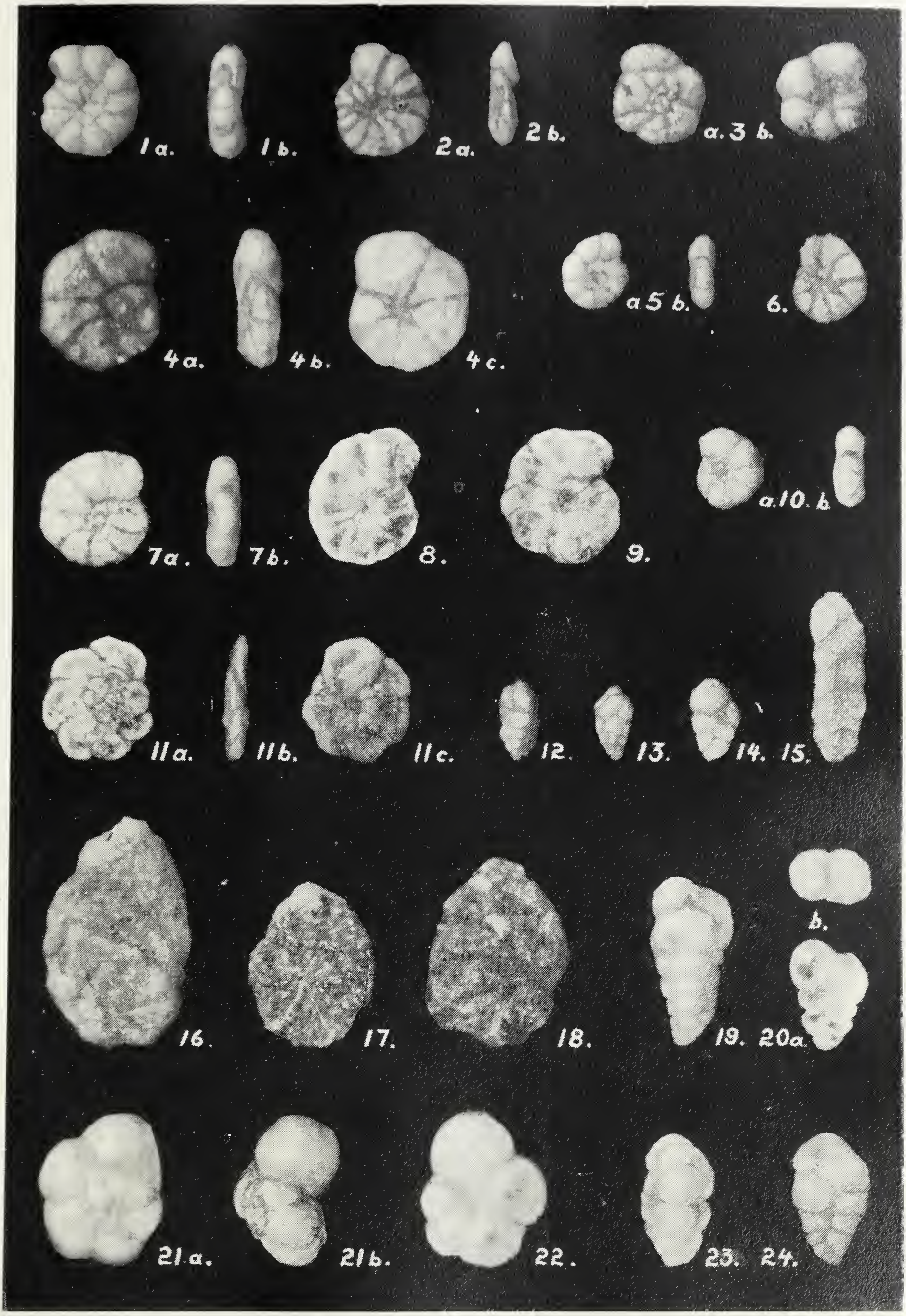
Fig. 38, 39: Spiroplectammina ST-838-B, X45. Fig. 38, paratype, from central part of Kaskapau formation, directly above the Pouce Coupe sand, locality G45-19, Pouce Coupe River, Alberta; slightly retouched photograph of paratype. Fig. 39, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 838 feet, 4 feet above the top of the Pouce Coupe sand equivalent; slightly retouched photograph of holotype.

Fig. 40, 41: Verneuilina SR-1009-A, X45. Fig. 40, holotype, from lower part of Kaskapau formation, Imperial Spirit River #1 Well, at a depth of 1009 feet, 100 feet above the base of the Kaskapau; slightly retouched photograph of holotype. Fig. 41, paratype, from lower part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 916 feet, 139 feet above the base of the Kaskapau; slightly retouched photograph of a compressed paratype.

PLATE III

LOWER TURONIAN FORAMINIFERA

CENTRAL PART OF KASKAPAU FORMATION


1a.
1b.
2a.
2b.
a.3 b.
4a.
4b.
4c.
a5 b.
6.
7a.
7b.
8.
9.
a.10. b.
11a.
11b.
11c.
12.
13.
14.
15.
16.
17.
18.
19.
20a.
b.
21a.
21b.
22.
23.
24.

Explanation of Plate III

Fig. 1: Haplophragmoides G45-3-90-A, X45, holotype, from central part of Kaskapau formation, 90 feet above the "white chalcedonic bed", locality G45-3, Henderson Creek, Alberta; a, slightly retouched photograph of side view of holotype; b, slightly retouched photograph of peripheral view of holotype.

Fig. 2: Haplophragmoides G45-3-80-A, X45, holotype, from central part of Kaskapau formation, 80 feet above the "white chalcedonic bed", locality G45-3, Henderson Creek, Alberta; a, slightly retouched photograph of side view of holotype; b, slightly retouched photograph of peripheral view of holotype.

Fig. 3: Haplophragmoides S47-35-6-A, X45, holotype, from central part of Kaskapau formation, 6 feet above the "white chalcedonic bed", locality S47-35, Kiskatinaw River, British Columbia; a, slightly retouched photograph of more evolute side view of holotype; b, slightly retouched photograph of opposite side view of holotype.

Fig. 4: Haplophragmoides G45-4-55-A, X45, holotype, from central part of Kaskapau formation, 55 feet below the "white chalcedonic bed", locality G45-4, Henderson Creek, Alberta; a, slightly retouched photograph of partly evolute side view of holotype; b, slightly retouched photograph of peripheral view of holotype; c, slightly retouched photograph of involute side view of holotype.

Fig. 5, 6: Haplophragmoides G46-1-10-A, X45. Fig. 5, holotype, from central part of Kaskapau formation, 10 feet above base of Haplophragmoides ST-664-A zone, locality G46-1, Howard Creek, Alberta; 5a, slightly retouched photograph of side view of holotype; 5b, slightly retouched photograph of peripheral view of holotype. Fig. 6, paratype, from central part of Kaskapau formation, 65 feet above the "white chalcedonic bed", locality G45-3, Henderson Creek, Alberta; slightly retouched photograph of side view of partly crushed paratype.

Fig. 7, 8, 9: Haplophragmoides ST-664-A, X45. Fig. 7, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 664 feet, 178 feet above the top of the Pouce Coupe

(continued)

Fig. 7 (continued)

sand equivalent; 7a, slightly retouched photograph of side view of holotype; 7b, slightly retouched photograph of peripheral view of holotype. Fig. 8, paratype, from same locality, at a depth of 658 feet, 184 feet above the top of the Pouce Coupe sand equivalent; slightly retouched photograph of side view of partly crushed paratype. Fig. 9, paratype, from same locality, at a depth of 625 feet, 217 feet above the top of the Pouce Coupe sand equivalent; slightly retouched photograph of side view of crushed and flattened paratype.

Fig. 10: Haplophragmoides G45-3-145-B, X45, holotype, from central part of Kaskapau formation, 145 feet above the "white chalcedonic bed", locality G45-3, Henderson Creek, Alberta; a, slightly retouched photograph of side view of holotype; b, slightly retouched photograph of peripheral view of holotype.

Fig. 11: Trochammina ST-658-A, X45, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 658 feet, 184 feet above the top of the Pouce Coupe sand equivalent; a, slightly retouched photograph of dorsal view of holotype; b, slightly retouched photograph of peripheral view of holotype; c, slightly retouched photograph of ventral view of holotype.

Fig. 12, 13, 14: Tritaxia ST-664-B, X45. Fig. 12, 13, holotype and paratype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 664 feet, 178 feet above the top of the Pouce Coupe sand equivalent; 12, slightly retouched photograph of holotype; 13, slightly retouched photograph of partly crushed paratype. Fig. 14, paratype from same locality, at a depth of 630 feet, 212 feet above the top of the Pouce Coupe sand equivalent; slightly retouched photograph of a crushed and flattened paratype.

Fig. 15: Tritaxia ST-618-A, X45, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 618 feet, 224 feet above the top of the Pouce Coupe sand equivalent; slightly retouched photograph of holotype.

Fig. 16: *Flabellammina* G45-3-145-A, X45, holotype, from central part of Kaskapau formation, 145 feet above the "white chalcedonic bed", locality G45-3, Henderson Creek, Alberta; slightly retouched photograph of holotype.

Fig. 17, 18: *Flabellammina* G45-3-50-A; *Fig. 17*, X38, holotype, from central part of Kaskapau formation, 50 feet above the "white chalcedonic bed", locality G45-3, Henderson Creek, Alberta; slightly retouched photograph of holotype. *Fig. 18*, X45, paratype, from central part of Kaskapau formation, 85 feet below the "white chalcedonic bed", locality S47-36, Kiskatinaw River, British Columbia; slightly retouched photograph of paratype.

Fig. 19: *Gumbelitria* ST-596-A, X87, holotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 596 feet, 194 feet below the top of the Lower (Second) White Speckled Shale horizon; slightly retouched photograph of holotype.

Fig. 20: *Gumbelina globulosa* (Ehrenberg), X95, plesiotype, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 562 feet, 160 feet below the top of the Lower (Second) White Speckled Shale horizon; a, slightly retouched photograph of side view of plesiotype; b, slightly retouched photograph of apertural view of plesiotype.

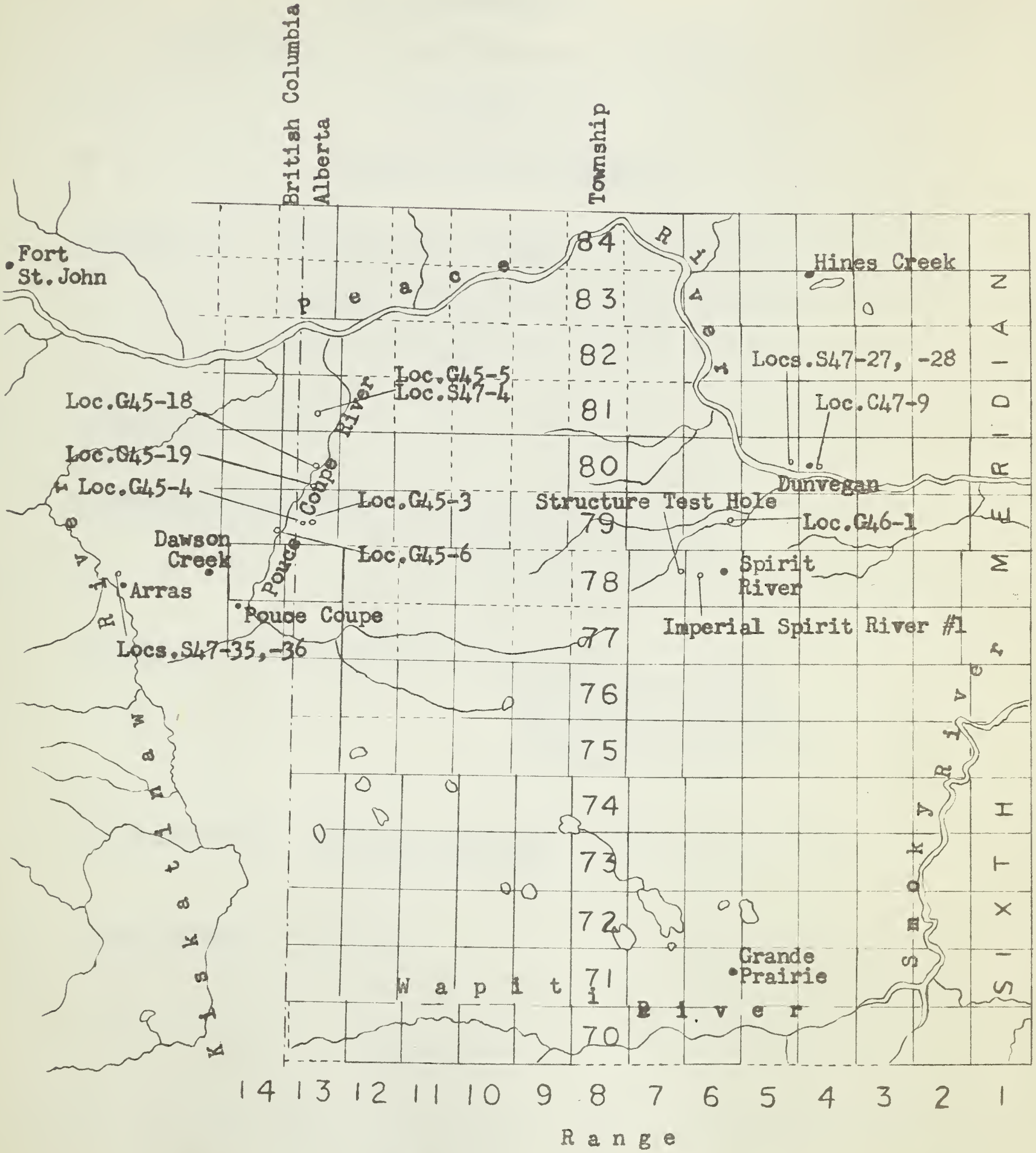
Fig. 21, 22: *Globigerina cretacea* d'Orbigny, X95, plesiotypes, from central part of Kaskapau formation, Imperial Spirit River Structure Test #A-337-1, at a depth of 515 feet, 113 feet below the top of the Lower (Second) White Speckled Shale horizon; 21a, slightly retouched photograph of dorsal view of plesiotype; 21b, slightly retouched photograph of peripheral view of plesiotype; 22, slightly retouched photograph of ventral view of another plesiotype.

Fig. 23, 24: *Gumbelitria cretacea* Cushman, X95. *Fig. 23*, plesiotype from central part of Kaskapau formation, Imperial Spirit River Structure Test #A337-1, at a depth of 562 feet, 160 feet below the top of the Lower (Second) White Speckled Shale horizon; slightly retouched photograph of plesiotype. *Fig. 24*, plesiotype, from same locality, at a depth of 566 feet, 164 feet below the top of the Lower (Second) White Speckled Shale horizon; slightly retouched photograph of plesiotype, showing aperture.

FIG. 9

LOCALITIES OF MICROFAUNAL SUITES

IN WESTERN PEACE RIVER AREA


British Columbia
Alberta
Township
Fort St.John
Peace River
Hines Creek
Locs.S47-27, -28
Loc.C47-9
Loc.G45-5
Loc.S47-4
Loc.G45-18
Loc.G45-19
Loc.G45-4
Loc.G45-3
Loc.G45-6
Pouce Coupe River
Dawson Creek
Arras
Pouce Coupe
Locs.S47-35,-36
Dunvegan
Structure Test Hole
Loc.G46-1
Spirit River
Imperial Spirit River #1
Kiskatinaw River
Wapiti River
Grande Prairie
Smoky River
SIXTH MERIDIAN
84
83
82
81
80
79
78
77
76
75
74
73
72
71
70
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Range

Scale 1 inch = 16 miles

J. H. Wall May,1951.

APPENDIX I

Identification of Foraminifera by Localities

PART I

Spirit River Localities

Section A: Foraminiferal Analysis of the Lower Turonian and Upper Cenomanian beds of the Imperial Spirit River Structure Test Hole #A-337-1

Location: Lsd.16 - Sec.24 - Tp.78 - Rge.7 W 6th Meridian

Lithologic Description: By John Newland, Geologist,
Imperial Oil Limited,
Subsurface Division,
Calgary, Alberta.

Megafossil Identification: By Dr. Colin H. Crickmay,
Staff Paleontologist,
Imperial Oil Limited,
Exploration Department,
Calgary, Alberta.

Sampling Method: Continuous chipping of cores, usually over two feet intervals.

Sample Weight: 40 grams.

. . .

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content
58	400-402	-2	442	Sh.,med.gy with fish remains	100%	Miliammina ? sp.......... 1

402' - Lower (Second) White Speckled Shale Marker
(Top of Middle Shale Member of the Colorado Group
in the Central Alberta Plains Area)

400-410 - Watinoceras sp.

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content
59	402-404	0	440	Sh.,dk.gy, soft, cal.,with buff cal. specks	100%	Miliammina ? sp........... 1
60	404-406	2	438	"	100%	Fish remains only
61	406-408	4	436	"	100%	"
62	408-410	6	434	"	40%	"

410' - Top of the Pelagic Microfaunal Zone
(Globigerina cretacea, Gumbelina globulosa)

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content
63	410-414	8	432	Sh.,med.gy, with small silt lenses, fish remains, cal., buff to white specks	70%	Globigerina cretacea....... 2 Gumbelina globulosa....... 2
64	414-420	12	428	"	100%	Fish remains only
65	420-430 (1½' core rec.)	18	422	Sh.,med.gy,with cal.white specks	100%	Gumbelina globulosa........ 1 Haplophragmoides sp........ 1
66	430-436	28	412	Sh.,med.gy,cal., numerous white specks, fish remains	100%	Haplophragmoides?sp........ 2
67	436-440	34	406	"	100%	Fish remains only
68	440-450 (2' core rec.)	38	402	Sh.,med.gy,cal., white specks,fish remains, shell fragments.	100%	Globigerina cretacea....... 3
69	450-460	48	392	Sh.,med.gy,cal. white specks	100%	Haplophragmoides sp........ 1

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated Percentage of total specimens picked	Microfaunal Content	
70	460-470 (1' core rec.)	58	382	Sh.,as above	100%	Globigerina cretacea...... Gumbelina globulosa....... Haplophragmoides sp.......	3 2 2
71	470-475	68	372	Sh.,med.gy.,cal. white specks, fish remains	100%	Globigerina cretacea...... Gumbelina globulosa....... Gumbelitria cretacea......	3 1 4
72	475-480	73	367	"	100%	Globigerina cretacea...... Gumbelina globulosa....... Gumbelitria cretacea......	3 3 8
73	480-484	78	362	"	25%	Globigerina cretacea...... Gumbelina globulosa....... Gumbelitria cretacea......	12 25 8
74	484-488	82	358	"	100%	Gumbelina globulosa....... Gumbelitria cretacea......	6 2
75	488-490	86	354	"	100%	Gumbelina globulosa.......	3
76	490-494	88	352	Sh.,as above, white specks,fish remains	100%	Globigerina cretacea...... Gumbelina globulosa.......	6 9
77	494-498	92	348	"	100%	Fish remains only	
78	498-500	96	344	"	100%	Globigerina cretacea...... Gumbelina globulosa....... Gumbelitria cretacea......	1 17 4
	500-510	- Watinoceras sp					
79	500-502	98	342	Sh., as above, white specks	100%	Globigerina cretacea...... Gumbelina globulosa.......	3 5
80	502-504	100	340	"	100%	Globigerina cretacea...... Gumbelina globulosa.......	6 9
81	504-506	102	338	"	100%	Globigerina cretacea...... Gumbelina globulosa.......	7 12
82	506-508	104	336	"	100%	Globigerina cretacea...... Gumbelina globulosa....... Gumbelitria cretacea......	8 23 1

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
83	508-510	106	334	"	50%	Globigerina cretacea........ Gumbelina globulosa......... Gumbelitria cretacea........	5 1 1
84	510-515	108	332	Sh., as above, white specks, fish remains	100%	Globigerina cretacea ?......	1
85	515-520	113	327	"	85%	Globigerina cretacea........ Gumbelina globulosa.........	62 5
86	520-525	118	322	Sh.,as above, white specks, fish remains, small silt and sand lenses.	40%	Globigerina cretacea........	5
87	525-530	123	317	"	35%	Fish remains only.	
88	530-535	128	312	"	40%	Globigerina cretacea........ Gumbelina globulosa.........	7 2
89	535-540	133	307	"	50%	Globigerina cretacea........ Gumbelina globulosa.........	2 3
90	540-550 (0'6" core rec.)	138	302	Sh., as above, white specks, silt and sand lenses	60%	Globigerina cretacea........ Gumbelina globulosa.........	53 4
91	550-552.5	148	292	Sh., as above, white specks, fish remains,silt and sand lenses.	85%	Globigerina cretacea........ Gumbelina globulosa......... Gumbelitria cretacea........	4 9 5
92	552.5-555	150.5	289.5	"	70%	Globigerina cretacea........ Gumbelina globulosa......... Gumbelitria cretacea........	40 7 2
93	555-557.5	153	287	"	80%	Globigerina cretacea........ Gumbelina globulosa......... Gumbelitria cretacea........ " ST-596-A........	42 24 27 2
94	557.5-560	155.5	284.5	"	85%	Globigerina cretacea........ Gumbelina globulosa......... Gumbelitria cretacea........	27 11 7

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
95	560-562	158	282	Sh., as above, white specks	40%	Globigerina cretacea..... Gumbelina globulosa...... Gumbelitria cretacea..... " ST-596-A.....	14 16 45 8
96	562-564	160	280	"	10%	Globigerina cretacea..... Gumbelina globulosa...... Gumbelitria cretacea..... " ST-596-A.....	27 44 40 2
97	564-566	162	278	"	15%	Globigerina cretacea..... Gumbelina globulosa...... Gumbelitria cretacea..... " ST-596-A.....	5 8 56 2
98	566-568	164	276	"	10%	Globigerina cretacea..... Gumbelina globulosa...... Gumbelitria cretacea..... " ST-596-A.....	2 3 67 10
99	568-570	166	274	"	90%	Globigerina cretacea..... Gumbelina globulosa...... Gumbelitria cretacea.....	3 3 24
100	570-574	168	272	Sh., as above, white specks, fish remains.	100%	Gumbelitria cretacea..... Gumbelitria ST-596-A.....	59 5
101	574-577	172	268	"	80%	Gumbelina globulosa....... Gumbelitria cretacea......	1 5
102	577-580	175	265	"	60%	Globigerina cretacea...... Gumbelina globulosa....... Gumbelitria cretacea......	1 1 24
103	580-584	178	262	Sh., as above, white specks, silty lenses.	60%	Globigerina cretacea...... Gumbelina globulosa....... Gumbelitria cretacea...... " ST-596-A......	3 1 25 1
104	584-588	182	258	"	40%	Gumbelitria cretacea...... Haplophragmoides ST-664-A.	21 2
105	588-590	186	254	"	90%	Globigerina cretacea...... Gumbelitria cretacea......	1 8

590' - Base of the Pelagic Microfaunal Zone (Globigerina cretacea, Gumbelina globulosa)

- Top of the Haplophragmoides ST-664-A Zone
- Top of the Tritaxia ST-618-A Subzone

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimenspicked	Microfaunal Content	
106	590-592	188	252	Sh., as above, white specks, fish remains, shell fragments, silty lenses.	80%	Gumbelitria cretacea........	23
						Haplophragmoides ST-664-A...	25
						Tritaxia ST-618-A...........	10
						" ST-644-B...........	1
107	592-594	190	250	"	40%	Gumbelitria cretacea........	4
						" ST-596-A........	1
						Haplophragmoides ST-664-A...	26
						Tritaxia ST-664-B...........	20
108	594-596	192	248	"	50%	Gumbelina globulosa.........	1
						Gumbelitria cretacea........	13
						" ST-596-A........	2
						Haplophragmoides ST-664-A...	7
						Tritaxia ST-618-A...........	2
						" ST-664-B...........	3
109	596-598	194	246	"	40%	Gumbelitria cretacea........	53
						" ST-596-A........	8
						Haplophragmoides ST-664-A...	25
						Tritaxia ST-618-A...........	1
						" ST-664-B...........	7
110	598-600	196	244	"	70%	Gumbelitria cretacea........	18
						" ST-596-A........	2
						Haplophragmoides ST-664-A...	3
111	600-604.5	198	242	Sh., as above, few white specks and fish remains, silty lenses.	50%	Gumbelitria cretacea........	33
						Haplophragmoides ST-664-A...	6
						Tritaxia ST-618-A...........	2
						" ST-664-B...........	4
112	604.5-610	202.5	237.5	"	50%	Haplophragmoides ST-664-A...	8
						Tritaxia ST-618-A...........	1
						" ST-664-B...........	17
113	610-614	208	232	Sh., as above, scattered white specks, shell fragments and fish remains.	70%	Negligible.	

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
114	614-618	212	228	"	50%	Haplophragmoides ST-664-A....	4
						Tritaxia ST-618-A...........	10
						" ST-664-B...........	6
						Trochammina sp...............	1
115	618-620	216	224	"	100%	Haplophragmoides ST-664-A....	30
						Tritaxia ST-618-A...........	8
						" ST-664-B...........	5
	620'	- Base of the Tritaxia ST-618-A Subzone					
	620-630	Watinoceras sp.					
116	620-622.5	218	222	Sh., med. gy., slightly cal. along partings, fish remains, shell fragments	90%	Gumbelitria cretacea.........	2
						" ST-596-A.........	1
						Haplophragmoides ST-664-A....	37
117	622.5-625	220.5	219.5	"	90%	Gumbelitria cretacea.........	5
						" ST-596-A.........	1
						Haplophragmoides ST-664-A....	57
118	625-627.5	223	217	"	50%	Gumbelitria cretacea.........	6
						Haplophragmoides ST-664-A....	59
119	627.5-630	225.5	214.5	As above, with a 2" shaly ironstone band at base.	50%	Gumbelitria cretacea.........	16
						" ST-596-A.........	3
						Haplophragmoides ST-664-A....	23
120	630-632	228	212	Sh., as above, few scattered white specks, fish remains	15%	Gumbelitria cretacea.........	36
						" ST-596-A.........	12
						Haplophragmoides ST-664-A....	66
						Marginulina? sp..............	1
						Tritaxia ST-664-B............	12
121	632-634	230	210	"	20%	Gumbelitria cretacea.........	9
						" ST-596-A.........	2
						Haplophragmoides ST-664-A....	85
						" sp..........	1
						Milliammina sp...............	2
						Tritaxia ST-664-B............	4
122	634-636	232	208	"	50%	Gumbelitria cretacea.........	10
						" ST-596-A.........	1
						Haplophragmoides ST-664-A....	35
						" sp..........	1
						Miliammina sp................	1
						Tritaxia ST-664-B............	5

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
123	636-638	234	206	"	50%	Gumbelitria cretacea.........	4
						" ST-596-A.........	1
						Haplophragmoides ST-664-A....	23
						" sp..........	15
						Tritaxia ST-664-B............	16
					♝	Dictyomitra multicostata?....	1
124	638-640	236	204	"	50%	Gumbelitria cretacea.........	1
						Haplophragmoides ST-664-A....	34
						" sp..........	1
						Tritaxia ST-664-B............	3
						Ostracod unident.	
125	640-645	238	202	Sh., as above, scattered white specks.	50%	Gumbelitria cretacea.........	12
						" ST-596-A.........	2
						Haplophragmoides ST-664-A....	18
						" sp..........	7
						Tritaxia ST-664-B............	12
126	645-650	243	197	"	50%	Gumbelitria cretacea.........	10
						" ST-596-A.........	4
						Haplophragmoides ST-664-A....	26
						Tritaxia ST-664-B............	3
	650-660	- Inoceramus sp, Watinoceras sp.					
	650'	- Top of Trochammina ST-658-A Subzone					
127	650-652	248	192	Sh., as above, scattered white specks, fish remains	50%	Gumbelitria cretacea.........	4
						Haplophragmoides ST-664-A....	11
						Tritaxia ST-664-B............	3
						Trochammina ST-658-A.........	30
						" sp..............	2
						Verneuilininae-unclassified..	4
					♝	Dictyomitra multicostata.....	1
128	652-654	250	190	"	25%	Gumbelitria cretacea.........	1
						Haplophragmoides ST-664-A....	12
						Trochammina ST-658-A.........	18
129	654-656	252	188	"	50%	Gumbelitria ST-596-A.........	2
						Haplophragmoides ST-664-A....	16
						Trochammina ST-658-A.........	23
130	656-658	254	186	"	50%	Haplophragmoides ST-664-A....	18
						Trochammina ST-658-A.........	19

♝ a radiolarian.

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
131	658-660	256	184	"	2%	Gumbelitria cretacea	7
						Haplophragmoides ST-664-A	52
						Tritaxia ST-664-B	2
						Trochammina ST-658-A	39
						" undiff.	8
132	660-662	258	182	Sh., as above, scattered white specks, fish remains, shell fragments, small silty lenses	2%	Gumbelitria cretacea	3
						" ST-596-A	1
						Haplophragmoides ST-664-A	21
						Trochammina ST-658-A	14
						" undiff.	4
						Verneuilina sp.	1
133	662-664	260	180	"	2%	Gumbelitria cretacea	2
						Haplophragmoides ST-664-A	8
						Trochammina ST-658-A	38
						" undiff.	4
						Verneuilininae unclassified	3
134	664-666	262	178	"	3%	Gumbelitria cretacea	1
						Haplophragmoides ST-664-A	21
						Tritaxia ST-664-B	6
						Trochammina ST-658-A	18
						Verneuilininae unclassified	2
135	666-668	264	176	"	4%	Gumbelitria cretacea	1
						Haplophragmoides ST-664-A	12
						Tritaxia ST-664-B	2
						Trochammina ST-658-A	31
						" undiff.	2
136	668-670	266	174	"	5%	Gumbelitria cretacea	1
						Haplophragmoides ST-664-A	10
						Tritaxia ST-664-B	1
						Trochammina ST-658-A	33
	670-680	-	Inoceramus sp, Watinoceras cf. reesidei				
137	670-674	268	172	As above.	5%	Gumbelitria cretacea	28
						" ST-596-A	8
						Haplophragmoides ST-664-A	4
						" sp.	1
						Tritaxia ST-664-B	6
						Trochammina ST-658-A	34
138	674-678	272	168	"	2%	Haplophragmoides ST-664-A	1
						Trochammina ST-658-A	43
						" undiff.	3
						Verneuilininae unclassified	3

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content
139	678-680	276	164	"	25%	Gumbelitria cretacea......... 1 Haplophragmoides ST-664-A.... 3 Trochammina ST-658-A......... 14 " sp............... 1
	680-700	- Inoceramus sp, Scaphites delicatulus, Watinoceras cf. reesidei				
140	680-682	278	162	Sh., as above, scattered white specks, fossils	50%	Haplophragmoides ST-664-A..... 2 Trochammina ST-658-A......... 12 Verneuilininae unclassified.. 3
141	682-684	280	160	"	80%	Haplophragmoides ST-664-A.... 7 Trochammina ST-658-A......... 22
142	684-686	282	158	"	50%	Gumbelitria cretacea......... 3 Trochammina ST-658-A......... 21
143	686-688	284	156	"	60%	Haplophragmoides ST-664-A.... 9 Trochammina ST-658-A......... 1
144	688-690	286	154	"	80%	Haplophragmoides ST-664-A.... 9 Trochammina ST-658-A......... 2
145	690-700* (0'6" core rec.)	288	152	"	50%	Gumbelitria cretacea......... 4 Haplophragmoides ST-664-A.... 12 Trochammina ST-658-A......... 18
	700-710	- Watinoceras reesidei				
	700'	- Base of Trochammina ST-658-A Subzone				
146-147	700-704	298	142	Sh., as above, scattered white specks, fish remains.	100%	Negligible
148	704-706	302	138	"	100%	Haplophragmoides G46-1-10-A... 1
149	706-708	304	136	"	100%	Gumbelitria cretacea.......... 2 Haplophragmoides ST-664-A..... 8 " G46-1-10-A..... 1 Tritaxia ST-664-B............. 1
150	708-710	306	134	"	100%	Fish remains only.

* Disintegration of equivalent interval in the Imperial Spirit River #1 well failed to increase the microfaunal recovery.

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content
	710-720 *(779-789)	308	132	Sh., dk.gy.,fairly hard, mostly platy, a few fish scales; a 1" band of med.gy., f.g., ss. at base.	100%	Fish remains only.
	720-726 *(789-795)	318	122	Sh., dk.gy.,fairly hard, massive to platy; some 2" bands of very hard slightly silty sh.,with fish scales common; lenses of lt.gy., f.g., ss.	100%	Fish remains only.
	726-728 *(795-797)	324	116	"	50%	Haplophragmoides ST-664-A.... 32 " G46-1-10-A.... 4 Tritaxia ST-664-B........... 1
	728-730 *(797-799)	326	114	"	30%	Flabellammina G45-3-50-A..... 1 Haplophragmoides ST-664-A.... 57 Tritaxia ST-664-B........... 4
151	730-732.5	328	112	Sh.,med. gy., with silty lenses.	30%	Haplophragmoides ST-664-A.... 47
152	732.5-735	330.5	109.5	"	50%	Haplophragmoides ST-664-A.... 36 Verneuilininae unclassified.. 2
153	735-737.5	333	107	"	60%	Haplophragmoides ST-664-A.... 12 Dictyomitra multicostata?.... 1
154	737.5-740	335.5	104.5	"	60%	Haplophragmoides ST-664-A.... 24 Verneuilininae unclassified.. 3
	740'			- Base of Haplophragmoides ST-664-A Zone - Top of Ammobaculites ST-747-A Zone - Probable position of Cenomanian - Turonian Boundary		
155	740-745	338	102	Sh., med.gy., sdy., glauc.	25%	Ammobaculites ST-745-A....... 1 " ST-747-A....... 7 " G45-19-0-A....... 9 Dorothia ST-830-A............ 2 " ST-834-A............ 1 Haplophragmoides ST-740-A.... 1 " SR-1018-B.... 2 " undiff....... 11

* Intervals in parentheses are cored sections from the Imperial Spirit River #1 well which were examined, as no core recovery was obtained over the equivalent intervalsin the A337-1 test hole.

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimenspicked	Microfaunal content	
156	745-747.5	343	97	Sh., med. to dk.gy., pyrite tracings.	2%	Ammobaculites ST-745-A......	11
						" ST-747-A......	11
						" G45-19-0-A......	26
						" sp.*............	1
						Gumbelitria cretacea........	9
						Haplophragmoides ST-664-A...	2
						" ST-740-A...	9
						" ST-838-A...	1
						" undiff.....	6
						Tritaxia ST-664-B...........	1
157	747.5-750	345.5	94.5	"	5%	Ammobaculites ST-745-A......	1
						" ST-747-A......	7
						" G45-19-0-A......	13
						Gumbelitria cretacea........	12
						Haplophragmoides ST-664-A...	2
						" ST-740-A...	3
						" ST-838-A...	3
						" undiff.....	14
						Spirillina sp...............	2
						Textularia ST-747-A.........	7
						Tritaxia ST-664-B...........	1
						Trochammina ? sp.**.........	3
						" undiff........	2
						Verneuilina sp..............	4
						Dictyomitra multicostata ?..	1
158	750-752	348	92	Sh., med.gy., sdy., slightly glauc., pyrite	10%	Ammobaculites ST-745-A......	7
						" ST-747-A......	5
						" G45-19-0-A......	25
						Dorothia ST-830-A...........	1
						" ST-834-A...........	2
						Flabellammina sp............	3
						Gumbelitria cretacea........	5
						Haplophragmoides ST-664-A...	7
						" ST-740-A...	3
						" ST-838-A...	2
						" undiff.....	20
						Textularia ST-747-A.........	5
						Tritaxia ST-664-B...........	3
						Trochammina undiff..........	4
						Verneuilina sp..............	1

* a large elongate form similar to A. ST-747-A, but with six chambers in uniserial portion.

** a small completely pyritized form.

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content
159	752-754	350	90	"	10%	Ammobaculites ST-745-A........ 6
						" ST-747-A........ 4
						" G45-19-0-A........25
						Bathysiphon sp................ 1
						Gumbelitria cretacea.......... 8
						Haplophragmoides ST-664-A..... 3
						" ST-740-A..... 4
						" ST-850-A..... 1
						" SR-1011-B...... 1
						" undiff.........18
						Textularia ST-747-A........... 1
						Tritaxia sp................... 4
						Trochammina undiff............ 4
160	754-756	352	88	"	20%	Ammobaculites ST-747-A........ 1
						" G45-19-0-A....... 3
						Dorothia ST-834-A............. 2
						Gumbelitria ST-782-A ?........ 1
						Haplophragmoides ST-664-A..... 3
						" ST-850-A.....14
						" SR-1018-B..... 1
						" undiff........30
						Textularia ST-747-A........... 1
						Tritaxia sp................... 2
						Trochammina ST-812-A.......... 1
						" undiff............ 4
161	756-758	354	86	"	5%	Ammobaculites ST-745-A........ 3
						" ST-747-A........11
						" G45-19-0-A....... 6
						Haplophragmoides ST-740-A..... 2
						" ST-850-A.....24
						" ST-902-A..... 3
						" undiff.......15
						Trochammina undiff............ 4
162	758-760	356	84	"	10%	Ammobaculites ST-747-A....... 5
						" G45-19-0-A...... 2
						Dorothia ST-834-A............ 3
						Gumbelitria cretacea......... 4
						Haplophragmoides ST-740-A.... 1
						" ST-850-A.... 14
						" ST-902-A.... 4
						" undiff...... 11
						Trochammina undiff........... 2 (ST-910-A type)
163	760-762	358	82	Sh., as above, ss. lenses.	25%	Ammobaculites G45-19-0-A..... 6
						Dorothia ? sp................ 2

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
(cont'd)							
163	760-762	358	82	Sh., as above, ss. lenses.	25%	Gumbelitria cretacea.........	3
						Haplophragmoides ST-664-A....	8
						" ST-740-A....	1
						" ST-838-A....	1
						" SR-1011-B....	2
						" undiff.......	25
						Trochammina ST-910-A.........	2
						" undiff..........	5
164	762-763	360	80	"	25%	Ammobaculites ST-745-A.......	3
						" ST-747-A.......	4
						" G45-19-0-A......	17
						Haplophragmoides ST-664-A....	5
						" undiff......	5
165	763-770 (2' core rec.)	361	79	*1' Sh., as above, 1' Ss.,buff, med., texture,limy,glauc.	50%	Ammobaculites sp.**..........	1
						Gumbelitria cretacea.........	2
						Haplophragmoides undiff......	2
	763' - Top* of "Spirit River" Sand						
166	770-774.5	368	72	Ss.,buffish-grey, f.g.,shaly with med.gy.sdy.,sh., breaks, fossils.	50%	Haplophragmoides ST-850-A....	3
						" undiff......	8
						Trochammina? sp ***..........	6
167	774.5-777	372.5	67.5	"	50%	Haplophragmoides ST-850-A....	2
						" undiff......	5
						Trochammina undiff...........	2
---	777-782	375	65	"		Nil	
	777' - Base****of "Spirit River" Sand						
168	782-784	380	60	Sh., med.gy., sdy., pyrite.	50%	Ammobaculites ST-745-A.......	1
						Gumbelitria ST-782-A.........	1
						Haplophragmoides ST-850-A....	4
						" undiff.....	16
						Tritaxia sp..................	1

* Exact top of "Spirit River" Sand taken from electrolog due to poor core rec. (this 1' shale bed and contained microfauna is probably immediately above the top of the sand)

** a gigantic type.

*** a small completely pyritized form.

**** electrolog pick. Actual base is gradational, with interval 777-782 being primarily interbedded sand and shale.

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
169	784-786	382	58	"	50%	Ammobaculites G45-19-0-A.....	2
						Dorothia ST-834-A............	1
						Dorothia ? sp................	3
						Gumbelitria ST-782-A.........	2
						Haplophragmoides ST-850-A....	13
						" undiff......	15
						Trochammina sp...............	1
170	786-788	384	56	"	20%	Ammobaculites ST-745-A.......	1
						" ST-747-A.......	1
						" G45-19-0-A......	7
						Dorothia ? sp................	3
						Gumbelitria cretacea.........	2
						Haplophragmoides ST-740-A....	3
						" ST-850-A....	3
						" undiff......	9
						Proteonina sp................	1
						Tritaxia sp..................	1
						Trochammina undiff...........	3
171	788-790	386	54	"	85%	Ammobaculites G45-19-0-A.....	2
						Gumbelitria cretacea.........	1
						Haplophragmoides ST-740-A....	4
						" undiff......	13
172	790-792	388	52	"	50%	Ammobaculites G45-19-0-A.....	1
						" undiff.........	3
						Gumbelitria cretacea.........	1
						Haplophragmoides ST-740-A....	3
						" undiff......	3
						Trochammina sp...............	1
173	792-794	390	50	Sh., med.gy., sdy.	50%	Ammobaculites ST-745-A.......	1
						" ST-747-A.......	1
						" G45-19-0-A......	9
						Ammobaculites undiff.........	5
						Dorothia ? sp................	3
						Gumbelitria cretacea.........	4
						Haplophragmoides ST-664-A....	3
						" ST-740-A....	3
						" undiff......	13
						Trochammina ST-910-A.........	2
						" undiff...........	10

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
174	794-796	392	48	"	30%	Ammobaculites ST-745-A	2
						" ST-747-A	5
						" G45-19-0-A	11
						" undiff.	3
						Dorothia ? sp.	3
						Haplophragmoides ST-664-A	11
						" undiff.	14
						Tritaxia ST-664-B ?	6
						Trochammina undiff.	2
175	796-798	394	46	"	20%	Ammobaculites ST-745-A	2
						" ST-747-A.?	2
						" G45-19-0-A	13
						Haplophragmoides ST-664-A	4
						" ST-740-A	2
						" undiff.	6
						Tritaxia sp.	1
						Trochammina undiff.	4
176	798-800	396	44	"	40%	Ammobaculites ST-745-A	2
						" G45-19-0-A	3
						" undiff.*	6
						Haplophragmoides ST-664-A	5
						" ST-740-A	4
						" ST-838-A	1
						" undiff.	7
						Reophax sp.	2
						Tritaxia sp.	2
						Trochammina undiff.	5
177	800-804	398	42	Sh.,sdy., as above	20%	Ammobaculites ST-745-A	5
						" ST-747-A	11
						" G45-19-0-A	8
						Dorothia ST-830-A	1
						Gumbelitria cretacea	3
						Haplophragmoides ST-664-A	7
						" ST-740-A	4
						" SR-1018-B	2
						Haplophragmoides undiff.	9
						Reophax ? sp.	1
						Trochammina ST-812-A	13
						" ST-910-A	5
						" undiff.	14
						Dictyomitra multicostata?	4

* A. ST-745-A or ST-747-A.

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
178	804-807	402	38	"	35%	Ammobaculites ST-745-A.......	1
						" ST-747-A.......	6
						" G45-19-0-A.......	9
						Dorothia ST-834-A............	2
						Gumbelitria cretacea.........	1
						Haplophragmoides ST-664-A....	2
						" ST-740-A....	2
						" undiff......	3
						Trochammina ST-812-A.........	6
						" ST-910-A.........	3
						" undiff...........	17
179	807-810	405	35	"	50%	Ammobaculites ST-745-A.......	1
						" G45-19-0-A.......	1
						" sp *.............	1
						Haplophragmoides ST-664-A....	4
						" undiff......	2
						Trochammina ST-812-A.........	3
						" ST-910-A.........	1
						" undiff..........	4
180	810-812	408	32	Sh., med. gy., sdy., pyritic, fossil fragments.	5%	Ammobaculites ST-745-A.......	8
						" ST-747-A.......	3
						" G45-19-0-A.......	7
						" sp **............	2
						" sp ***...........	1
						" undiff.****......	8
						Dorothia ST-830-A............	1
						" ST-834-A............	3
						Haplophragmoides ST-664-A.....	6
						" ST-740-A....	2
						" SR-1018-B....	3
						" undiff.......	8
						Reophax sp..................	1
						Trochammina ST-812-A.........	10
						" ST-910-A.........	4
						" undiff...........	13
						Ostracod unident.	

* fragment of a gigantic form.

** a gigantic form.

*** large elongate form similar to A. ST-747-A, but with five to six chambers in uniserial portion.

**** A. ST-745-A or ST-747-A.

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
181	812-814	410	30	"	35%	Ammobaculites ST-745-A.......	1
						" ST-747-A.......	4
						" G45-19-0-A......	9
						Gumbelitria cretacea.........	6
						" ST-596-A.........	1
						" ST-782-A.........	1
						Haplophragmoides ST-664-A....	5
						" ST-740-A....	6
						" undiff......	25
						Trochammina ST-812-A.........	3
						" ST-910-A.........	4
						" undiff...........	28
182	814-816	412	28	"	35%	Ammobaculites ST-745-A.......	4
						" ST-747-A.......	2
						" G45-19-0-A......	3
						Gumbelitria cretacea.........	15
						" ST-596-A.........	2
						Dorothia ST-830-A............	3
						Haplophragmoides ST-664-A....	6
						" SR-1018-A....	2
						" undiff......	7
						Trochammina ST-812-A.........	11
						" ST-910-A.........	1
						" undiff...........	8
						Ostracod unident.	
183	816-818	414	26	"	50%	Ammobaculites ST-745-A.......	2
						" ST-747-A.......	1
						" G45-19-0-A......	2
						" undiff *........	4
						" undiff.**.......	2
						Gumbelitria cretacea..........	4
						Haplophragmoides ST-664-A....	7
						" ST-740-A....	4
						" undiff......	7
						Trochammina ST-812-A.........	11
						" ST-910-A.........	4
						" undiff...........	14
184	818-820	416	24	"	35%	Ammobaculites ST-745-A.......	2
						" ST-747-A.......	3
						" G45-19-0-A......	3
						" sp ***...........	2
						" undiff...........	5
						Dorothia ST-830-A............	1

* A. ST-745-A or ST-747-A

** large forms.

*** gigantic types.

(Core #184 - continued)

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
(cont'd)							
184	818-820	416	24	"	35%	Dorothia ST-834-A	1
						Gumbelitria cretacea	9
						" ST-596-A	2
						Haplophragmoides ST-664-A	3
						" SR-1018-B	3
						" undiff.	9
						Robulus sp.	1
						Trochammina ST-812-A	8
						" ST-910-A	2
						" undiff.	8
185	820-825	418	22	Sh., as above, pyrite tracings	15%	Ammobaculites ST-745-A	5
						" ST-747-A	2
						" undiff.★	3
						" sp ★★	1
						Haplophragmoides ST-664-A	5
						" undiff.	9
						Trochammina undiff.	5
186	825-830	423	17	"	40%	Ammobaculites ST-745-A	3
						" ST-747-A	3
						" G45-19-0-A	5
						" undiff.	2
						Haplophragmoides ST-664-A	1
						" ST-838-A	2
						" ST-850-A	6
						" undiff.	3
						Trochammina ST-812-A	2
						" undiff.	3
						Dictyomitra multicostata?	1
187	830-834	428	12	"	35%	Ammobaculites ST-747-A	7
						Dorothia ST-830-A	5
						" ST-834-A	3
						Haplophragmoides ST-838-A	6
						" undiff.	10
						Spiroplectammina ST-838-B ★★★	10
						Trochammina ST-812-A	5
						Dictyomitra multicostata?	10

★ A. ST-745-A or ST-747-A

★★ large form.

★★★ includes three young specimens.

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
188	834-838	432	8	"	25%	Ammobaculites ST-747-A......	6
						Dorothia ST-830-A..........	8
						" ST-834-A..........	6
						" undiff............	3
						Haplophragmoides ST-838-A..	4
						" ST-850-A..	2
						" ST-902-A..	3
						" SR-1018-B..	4
						" undiff.....	12
						Spiroplectammina ST-838-B..	4
						Trochammina ST-812-A.......	1
						" ST-910-A.......	1
						Dictyomitra multicostata?..	7
189	838*-840	436	4	"	10%	Ammobaculites ST-745-A.....	2
						" ST-747-A.....	14
						" G45-19-0-A....	1
						Dorothia ST-830-A..........	9
						" ST-834-A..........	3
						Haplophragmoides ST-664-A..	4
						" ST-740-A..	1
						" ST-838-A..	9
						" ST-850-A..	2
						" SR-1011-B..	1
						" undiff.....	6
						Reophax sp.................	1
						Spiroplectammina ST-838-B..	13
						Trochammina ST-812-A.......	4
						" undiff.........	4
190	840-850 (2' core rec.)	438	2	Sh., as above; lenses of buff, f.g., glauc. ss., pyrite tracings	50%	Ammobaculites ST-747-A.....	4
						" G45-19-0-A....	3
						Dorothia ST-830-A..........	2
						" ST-834-A..........	2
						Haplophragmoides ST-740-A..	2
						" undiff....	15

842' - Base of Ammobaculites ST-747-A Zone
- Top** of Pouce Coupe Sandstone Member Equivalent

Acme of Dorothia ST-830-A, ST-834-A
* " " Haplophragmoides ST-838-A
" " Spiroplectammina ST-838-B

** Electrolog pick. In case of poor core recovery, it is almost invariably the sand which is lost.

Core Sample	Depth	Footage below Second White Specks Marker	Footage above Pouce Coupe Sand Equivalent	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
191	850-860	---	---	Ss., buffish-grey f.g., shaly, glauc. pyrite stemming	40%	Ammobaculites G45-19-0-A....	9
						Gaudryina ST-876-A..........	1
						Haplophragmoides ST-850-A...	17
						" ST-902-A...	3
						" undiff.....	8
						Spiroplectammina ST-838-B...	2

854' - Base** of Pouce Coupe Sandstone Member Equivalent

- Top of Gaudryina ST-876-A Zone

** Electrolog pick. In case of poor core recovery, it is almost invariably the sand which is lost.

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
192	860-863.5	6	195	Ss., as above, higher sh.content, pyrite.	40%	Ammobaculites G45-19-0-A...	5
						Gaudryina ? undiff.........	3
						Haplophragmoides ST-850-A..	7
						" ST-902-A..	5
						" undiff....	12
						Spiroplectammina ST-838-B..	4
						Trochammina ST-910-A.......	1
						Verneuilina SR-1009-A......	2
193	863.5-867	9.5	191.5	"	50%	Gaudryina ST-876-A.........	1
						Haplophragmoides ST-850-A..	7
						" undiff....	4
						Spiroplectammina ST-838-B..	1
						Trochammina ST-910-A.......	1
						Verneuilina SR-1009-A......	1
194	867-870	13	188	"	50%	Ammobaculites G45-19-0-A...	2
						" undiff.......	1
						Haplophragmoides ST-740-A..	3
						" ST-850-A..	5
						" ST-902-A..	3
						" undiff....	4
						Spiroplectammina ST-838-B..	1
	870' - Top of Trochammina ST-910-A Subzone						
195	870-872	16	185	Sh., med.gy.,sdy. to silty, pyrite tracings, Lingulas	50%	Haplophragmoides ST-850-A..	3
						" ST-902-A..	3
						Trochammina ST-910-A.......	11
196	872-874	18	183	"	50%	Gaudryina ST-876-A.........	6
						Haplophragmoides ST-850-A..	1
						" ST-902-A..	1
						" SR-1011-B..	3
						" undiff.....	12
						Spiroplectammina ST-838-B..	2
						Verneuilina SR-1009-A......	4
197	874-876	20	181	"	25%	Gaudryina ST-876-A.........	3
						" SR-1018-A.........	2
						Haplophragmoides ST-850-A..	7
						" ST-902-A..	7
						" undiff....	3
						Spiroplectammina ST-838-B..	1
						Trochammina ST-910-A.......	9
						Verneuilina SR-1009-A......	5

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
198	876★-878	22	179	"	1%	Gaudryina ST-876-A.........	1
						Haplophragmoides ST-850-A..	7
						" ST-902-A..	12
						" undiff....	4
						Quinqueloculina ? sp.......	1
						Spiroplectammina ST-838-B..	1
						Trochammina ST-910-A.......	40
						Verneuilina SR-1009-A......	9
199	878-880	24	177	"	1%	Gaudryina ST-876-A.........	1
						Haplophragmoides ST-850-A..	3
						" ST-902-A..	5
						" undiff....	4
						Trochammina ST-910-A.......	34
						Verneuilina SR-1009-A......	3
	880-890 - Modiolus sp.						
200	880-882.5	26	175	Sh.,as above, lenses of buff,f.g. mic., glauc.ss.; nodules of ss. and ironstone; Lingulas	10%	Flabellammina ? sp.........	1
						Gaudryina ST-876-A.........	4
						Haplophragmoides ST-902-A..	4
						" SR-1011-B.	1
						" undiff....	4
						Spiroplectammina ST-838-B..	2
						Trochammina ST-910-A.......	2
						Verneuilina SR-1009-A......	3
201	882.5-885	28.5	172.5	"	35%	Flabellammina ? undiff.....	2
						Haplophragmoides ST-902-A..	3
						Spiroplectammina ST-838-B..	1
						Trochammina ST-910-A.......	3
202	885-887.5	31	170	"	40%	Ammobaculites sp...........	1
						Haplophragmoides ST-850-A..	2
						" ST-902-A..	15
						Marginulina ? sp...........	1
						Trochammina ST-910-A.......	1
						" ST-956-C.......	1
203	887.5-890	33.5	167.5	"	40%	Ammobaculites undiff.......	2
						Gaudryina ST-876-A.........	1
						Haplophragmoides ST-902-A..	4
						" ST-958-A..	1
						Verneuilina SR-1009-A......	1
						Ostracod unident.	

★ Acme of Haplophragmoides ST-902-A
" " Trochammina ST-910-A

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
204	890-892	36	165	Sh., med. gy.,mic., pyrite tracings; Lingulas.	40%	Ammobaculites ST-930-A.....	2
						Gumbelitria cretacea.......	1
						Haplophragmoides ST-850-A..	1
						" ST-902-A..	9
						" ST-958-A..	1
						" SR-1011-B..	2
						" undiff.....	6
						Marginulina ? sp...........	1
						Trochammina ST-956-C.......	4
						Verneuilininae unclassified	4
						Ostracod unident.	
205	892-894	38	163	"	25%	Gaudryina ST-876-A.........	4
						" SR-1018-A........	1
						Haplophragmoides ST-902-A..	6
						" ST-958-A..	1
						" G45-5-85-A?.	1
						Textularia G45-5-220-A.....	2
						Trochammina ST-892-A.......	1
						" ST-956-C.......	4
206	894-896	40	161	"	25%	Gaudryina ST-876-A.........	6
						Haplophragmoides ST-902-A..	8
						Ostracod unident.	
207	896-898	42	159	"	50%	Ammomarginulina ST-956-B...	2
						Gaudryina ST-876-A.........	2
						Haplophragmoides ST-902-A..	8
						" SR-1011-B..	1
						" undiff.....	5
						Oolina ? sp................	1
						Quinqueloculina sp.........	1
						Textularia G45-5-220-A.....	5
208	898-900	44	157	"	35%	Gaudryina ST-876-A.........	1
						" SR-1018-A.........	2
						Haplophragmoides ST-902-A..	16
						" SR-1011-B..	1
						" undiff.....	3
						Proteonina SR-1034-A?.......	1
						" sp.............	1
						Verneuilina SR-1009-A......	2
209	900-902.5	46	155	Sh., as above,sdy., glauc.,mic.,carb. specks; Lingulas.	40%	Ammobaculites ST-930-A.....	1
						Ammomarginulina ST-956-B...	1
						Gaudryina ST-876-A.........	4
						Haplophragmoides ST-850-A..	1

(Core #209 continued)

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimenspicked	Microfaunal content
(cont'd)						
209	900-902.5	46	155	Sh., as above, sdy., glauc., mic., carb. specks; Lingulas.	40%	Haplophragmoides ST-902-A.. 8 " SR-1011-B.. 2 " undiff..... 4 Proteonina sp.............. 1 Quinqueloculina sp......... 1 Verneuilina SR-1009-A...... 6 " G45-5-110-C.... 1
210	902.5*-905	48.5	152.5	"	20%	Gaudryina ST-876-A......... 8 Haplophragmoides ST-902-A..13 " SR-1018-B.. 1 " undiff.....10 Textularia G45-5-220-A..... 2 Verneuilina SR-1009-A...... 1
211	905-907.5	51	150	"	60%	Ammobaculites undiff....... 2 Ammomarginulina ST-956-B... 4 Haplophragmoides ST-902-A..25 " SR-1018-B.. 2 " undiff.....25 Trochammina ST-892-A....... 1 Radiolarian unident.
212	907.5-910	53.5	147.5	"	20%	Gaudryina ST-876-A........ 4 " SR-1018-A....... 4 Haplophragmoides ST-902-A. 7 " undiff... 2 Trochammina ST-956-C...... 1 Verneuilina G45-5-110-C... 1
213	910-912	56	145	Sh., med.gy., sdy., with lenses of brown f.g., glauc., oil-saturated ss., trace of biotite.	35%	Haplophragmoides SR-1011-B. 1 " undiff... 9 Trochammina ST-910-A...... 24 Diatom unidentified
214	912-914	58	143	"	35%	Gaudryina ST-876-A........ 1 Haplophragmoides ST-902-A. 6 " SR-1018-B. 1 Trochammina ST-910-A...... 1

* Acme of Gaudryina ST-876-A.

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
215	914-916	60	141	"	5%	Gaudryina ST-876-A......	3
						" SR-1018-A.....	2
						Haplophragmoides ST-902-A	1
						" ST-958-A.	1
						" SR-1011-B.	3
						" SR-1018-B.	2
						Trochammina ST-910-A.....	17
216	916*-918	62	139	"	20%	Gaudryina ST-876-A.......	1
						" SR-1018-A.......	8
						Haplophragmoides ST-850-A	3
						" ST-902-A.	9
						" undiff...	10
						Reophax sp...............	1
						Spiroplectammina ST-838-B.	1
						Trochammina ST-910-A.....	26
						" ST-956-C.....	2
						Verneuilina SR-1009-A....	3
						" G45-5-110-C...	2
217	918-920	64	137	"	35%	Ammobaculites ST-930-A...	2
						Haplophragmoides ST-902-A	1
						" undiff..	5
						Trochammina ST-910-A.....	5
						Verneuilina SR-1009-A....	1
	920'	-	Base of Trochammina ST-910-A Subzone Base of Gaudryina ST-876-A Zone Top of Ammobaculites ST-930-A Zone				
218	920-922.5	66	135	Ss.,gy.to brown,f.g., quartzose, shaly in part, lenses of sh., thin bands of porous, oil stained ss.	40%	Haplophragmoides sp......	1
						Spirillina ? sp..........	1
219	922.5-925	68.5	132.5	"	70%	Spirillina ? sp.........	2
						Radiolarian unident.	

* Upper "acme" of Gaudryina SR-1018-A (Lower "acme" in the Spirit River #1 well at a depth of 1018').

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
220	925-927.5	71	130	"	60%	Ammobaculites ST-930-A......	2
						Flabellammina ? sp..........	2
						Haplophragmoides sp.........	2
						Spirillina ? sp.............	1
						Trochammina ST-892-A........	1
221	927.5-930	73.5	127.5	"		Nil	
222	930-932.5	76	125	Sh.,med.gy., sdy., lenses of light brown, f.g.,oil-stained ss., trace of glauc.	75%	Ammobaculites ST-930-A......	1
						Flabellammina SR-1013-A.....	1
223	932.5-935	78.5	122.5	"	90%	Ammobaculites ST-930-A......	1
						Ammomarginulina ST-956-B*...	4
						Flabellammina SR-1013-A.....	2
						Gumbelitria sp..............	2
						Haplophragmoides SR-1011-B..	1
						" undiff.....	5
						Trochammina ST-892-A........	1
						Verneuilina G45-5-110-C.....	1
224	935-937.5	81	120	"	75%	Ammobaculites ST-930-A......	5
						Ammomarginulina ST-956-A*...	4
						" ST-956-B....	1
						Flabellammina ST-937-A......	1
						Haplophragmoides undiff.....	6
						Trochammina ST-956-C........	1
						" S47-4-186-A.....	1
						Verneuilina SR-1009-A.......	1
						" G45-5-110-C.....	1
						Radiolarian unident.	
225	937.5-940**	83.5	117.5	"	90%	Ammobaculites ST-930-A......	6
						Ammomarginulina ST-956-A....	1
						Flabellammina ST-937-A......	3
						" SR-1013-A......	3
						Gaudryina SR-1018-A.........	1
						Gumbelitria ST-782-A........	1
						Haplophragmoides SR-1011-B..	2
						" undiff.....	6
						Trochammina ST-956-C........	3
						Ostracod unident.	
						Radiolarian unident.	

* small specimens

** acme of Flabellammina ST-937-A

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
226	940-942	86	115	Sh., as above; numerous lenses of oil-stained mic., quartz silt	25%	Ammobaculites ST-930-A.......	13
						Flabellammina SR-1013-A......	1
						" C47-9-95-A......	3
						" G45-5-115-A ?...	3
						Haplophragmoides ST-850-A....	1
						" ST-958-A....	3
						" SR-1011-B....	1
						Trochammina ST-892-A.........	2
						Verneuilina SR-1009-A........	4
						" G45-5-110-C......	1
227	942*-944	88	113	"	40%	Ammobaculites ST-930-A.......	23
						Flabellammina ST-937-A.......	1
						" SR-1013-A.......	4
						" C47-9-95-A......	4
						" G45-5-115-A ?...	1
						Haplophragmoides SR-1011-B...	1
						" SR-1018-B...	3
						" G45-5-85-A?..	1
						" undiff**.....	15
						Tritaxia sp.................	1
						Trochammina ST-892-A.........	2
						" ST-956-C.........	4
						Verneuilina SR-1009-A........	4
						" G45-5-110-C.......	1
228	944-946	90	111	"	25%	Ammobaculites ST-930-A.......	5
						Flabellammina C47-9-95-A.....	1
						Gaudryina SR-1018-A..........	1
						Haplophragmoides ST-850-A....	1
						" ST-958-A....	1
						" SR-1018-B....	2
						" undiff.......	8
						Trochammina ST-956-C.........	1
						" sp...............	1
						Verneuilina SR-1009-A........	3
						" G45-5-110-C.......	2
229	946-948	92	109	"	70%	Ammobaculites ST-930-A.......	3
						Ammomarginulina ST-956-A.....	1
						" undiff.......	2
						Haplophragmoides ST-958-A....	1
						" SR-1011-B...	2
						" G45-5-85-A...	1
						" G45-5-85-A?..	1
						" undiff **....	16
						Trochammina ST-956-C........	2

* Acme of Ammobaculites ST-930-A
" " Flabellammina C47-9-95-A

** about half of these are of the H. ST-850-A type

(Core #229 continued)

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
(Cont'd)							
229	946-948	92	109	"	70%	Trochammina S47-4-186-A.....	1
						Verneuilina SR-1009-A.......	1
						" G45-5-110-C......	1
						Ostracod unident.	
230	948-950	94	107	"	80%	Ammobaculites ST-930-A......	2
						Ammomarginulina ST-956-A....	3
						" undiff......	2
						Haplophragmoides ST-850-A...	5
						" undiff *...	12
						Trochammina ST-956-C........	1
						Verneuilina SR-1009-A.......	1
						" G45-5-110-C......	4
	950'	- Top of Trochammina ST-956-C Subzone					
231	950-952	96	105	Sh., as above; a few lenses of oil-stained silt, carb. specks.	70%	Ammobaculites ST-930-A......	4
						" undiff........	4
						Ammomarginulina ST-956-A....	1
						Flabellammina SR-1013-A.....	4
						" undiff........	4
						Gaudryina SR-1018-A.........	3
						Haplophragmoides ST-958-A...	1
						" SR-1018-B...	7
						" undiff **...	50
						Trochammina ST-956-C........	6

* about half of these are of the H. ST-850-A type

** mainly of the H. ST-850-A type.

Section B: Imperial Spirit River #1 Well

Location: Lsd.12 - Sec.20 - Tp.78 - Rge.6 W 6th Meridian

Lithologic Description: by George C. McClintock, Geologist,
Imperial Oil Limited,
Subsurface Division,
Edmonton, Alberta,
and the writer.

Megafossil Identification: by Dr. Colin H. Crickmay,
Staff Paleontologist,
Imperial Oil Limited,
Exploration Department,
Calgary, Alberta,
and the writer.

Sampling Method: Continuous chipping of cores, usually over two feet intervals.

Sample Weight: 45 grams

Remarks: For a continuous reading of the microfaunal content of the lower portion of the Kaskapau formation, the following section is connected to the base of the preceding one of the Structure Test hole. Exact correlation was made by the use of electrologs.

• • • •

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content
35	1005-1007	97	104	Sh., dk.gy.,very hard, massive,pyrite stringers; narrow bands and lenses of lt.gy.,f.g. ss.and silt.	50%	Ammomarginulina ST-956-A..... 1
						" ST-956-B..... 2
						" undiff....... 8
						Gaudryina SR-1018-A.......... 1
						Haplophragmoides ST-850-A.... 3
						" undiff.★....10
						Proteonina sp................ 2
						Reophax sp................... 2
36	1007-1009	99	102	"	50%	Ammobaculites undiff......... 2
						Ammomarginulina ST-956-A..... 2
						" ST-956-B..... 4
						" undiff.★★.... 3
						Flabellammina SR-1011-A...... 3
						" SR-1013-A...... 1
						Gaudryina SR-1018-A.......... 1
						Haplophragmoides G45-5-85-A?. 1
						" undiff.★....22
						Spiroplectammina ? sp........ 1
						Tritaxia sp.................. 1
						Trochammina ST-956-C......... 3
						Verneuilina SR-1009-A........ 1
37	1009-1011	101	100	"	40%	Ammobaculites ST-930-A....... 5
						Ammomarginulina ST-956-B..... 4
						" sp ★★★....... 2
						Flabellammina SR-1013-A...... 1
						Gaudryina SR-1018-A.......... 1
						Haplophragmoides ST-958-A.... 1
						" SR-1011-B.... 2
						" G45-5-85-A?.. 3
						" undiff ★.....20
						Proteonina sp................ 1
						Trochammina ST-892-A......... 4
						Verneuilina SR-1009-A........ 1
38	★★★★ 1011-1013	103	98	As above, but practically free of sand.	20%	Ammobaculites ST-930-A....... 7
						Ammomarginulina ST-956-B..... 7
						" undiff....... 2

(Core #38 continued)

★ mainly of the H. ST-850-A type.

★★ one of these is a gigantic form.

★★★ a gigantic form.

★★★★ Upper "acme" of Ammomarginulina ST-956-B (lower "acme" at 1060')
acmes of Flabellammina SR-1013-A, SR-1011-A
" of Haplophragmoides ST-958-A.

(Cont'd)

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
38	1011-1013	103	98		20%	Bathysiphon sp.	1
						Flabellammina SR-1011-A	2
						" SR-1013-A	4
						Gaudryina SR-1018-A	1
						Haplophragmoides ST-958-A	4
						" SR-1011-B	2
						" SR-1018-B	1
						" G45-5-85-A	1
						" undiff *	25
						Tritaxia undiff.	2
						Trochammina ST-892-A	1
						" ST-956-C	7
39	1013-1015	105	96	"	20%	Ammobaculites ST-930-A	4
						" undiff.	2
						Ammomarginulina ST-956-B	4
						" undiff.	6
						Flabellammina SR-1011-A	1
						" SR-1013-A	3
						Haplophragmoides ST-958-A	3
						" SR-1011-B	1
						" G45-5-85-A	3
						" undiff.	18
						Proteonina SR-1034-A	1
						" undiff.	2
						Tritaxia sp.	1
						Trochammina ST-892-A	1
						" ST-956-C	10
40	1015-1016.5	107	94	Sh., as above, with very little ss.	40%	Ammobaculites ST-930-A	5
						" G45-5-110-A	1
						" undiff.	4
						Ammomarginulina ST-956-B	2
						Flabellammina SR-1013-A	1
						Gaudryina SR-1018-A	1
						Haplophragmoides ST-958-A	2
						" SR-1011-B	3
						" G45-5-85-A?	2
						" undiff.	11
						Proteonina SR-1034-A	1
						" sp.	1
						Tritaxia undiff.	2
						Trochammina ST-956-C	10
						Verneuilina SR-1009-A	9

* mainly of the H. ST-850-A type.

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
41	1016.5-1018	108.5	92.5	Sh., as above, but lower half foot sdy., with lenses of lt.gy., f.g. ss. and silt.	60%	Ammobaculites undiff........	2
						Haplophragmoides undiff.....	4
						Trochammina ST-892-A........	4
						" ST-956-C........	2
42	1018★1018.5	110	91	Ss., brownish gy., f.g. to med.g.,hard, slightly limy, trace of glauc.	15%	Ammobaculites undiff........	5
						Ammomarginulina undiff......	3
						Gaudryina ST-876-A..........	2
						" SR-1018-A.........	7
						Haplophragmoides SR-1018-B..	2
						" undiff.....	5
						Proteonina SR-1034-A........	1
						Reophax sp..................	3
						Trochammina ST-892-A........	2
						" ST-956-C ★★.....	23
---	1018.5-1028	110.5	90.5	Ss., as above.		------------	
43	1028-1030	120	81	Sh.,dk.gy., very hard, massive, pyrite stringers, rather sdy., with lenses of lt.gy., f.g. ss. and silt.	40%	Ammobaculites ST-930-A......	3
						" undiff........	10
						Haplophragmoides undiff.....	7
						Proteonina undiff...........	2
						Tritaxia sp.................	1
						Trochammina ST-892-A........	1
						" ST-956-C........	3
						Trochammina sp..............	2
						Verneuilina SR-1009-A.......	1
						" G45-5-110-C......	1
44	1030-1032	122	79	"	40%	Ammobaculites sp............	1
						Verneuilina ? sp............	1
45	1032-1034	124	77	"	60%	Ammobaculites undiff........	3
						Ammomarginulina undiff......	12
						Reophax sp..................	1
						Trochammina ST-892-A........	4
						" ST-956-C........	4

★ Lower "acme" of Gaudryina SR-1018-A
(Upper "acme" in the Spirit River Structure Test at a depth of 916')

★★ probably includes some young forms of T. ST-892-A.

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
46	1034-1036*	126	75	Sh., as above, but nearly free of sand.	60%	Ammobaculites undiff........	6
						Haplophragmoides undiff **..	9
						Proteonina SR-1034-A........	2
						" undiff...........	4
						Trochammina ST-892-A........	1
						" ST-956-C........	8
						Verneuilina SR-1009-A.......	3
						" G45-5-110-C......	2
47	1036-1038	128	73	"	40%	Ammobaculites undiff........	3
						Ammomarginulina ST-956-B....	2
						" undiff......	3
						Haplophragmoides undiff.**..	12
						Proteonina SR-1034-A........	2
						" undiff...........	2
						Trochammina ST-956-C........	22
						" S47-4-186-A.....	1
						Verneuilina SR-1009-A.......	3
						" G45-5-110-C......	1
						" undiff..........	2
48-52	1038-1048	130	71	Sh., dk.gy., very hard, massive, with pyrite stringers; upper 7' is very sdy., with many lenses and crossbeds of lt.gy., f.g. ss. and silt; lower 3' consists of partially slickensided, dk.gy.sh. with very little ss.		Nil	
	1048-1054	- Lingula sp					
53	1048-1050	140	61	Sh., dk.gy., very hard, massive, slightly sdy. in places, pyrite stringers.	90%	Ammomarginulina sp..........	1
						Textularia G45-5-220-A......	9
						Tritaxia ? sp...............	2
						Ostracod unident.	

* Acme of Proteonina SR-1034-A.

** mainly of the H. ST-850-A type.

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content
54	1050-1052	142	59	"	60%	Ammobaculites ST-930-A....... 7 Ammomarginulina ST-956-A..... 2 " ST-956-B..... 2 " undiff........ 7 Gaudryina sp................. 2 Haplophragmoides undiff...... 4 Trochammina ST-892-A......... 2 " ST-956-C ★.......30 Verneuilina SR-1009-A........ 4 " G45-5-110-C...... 2 Radiolarian unident.
55	1052-1054	144	57	"	60%	Ammobaculites undiff........ 2 Ammomarginulina ST-956-A.... 1 " ST-956-B.... 1 " undiff...... 3 Trochammina ST-892-A........ 2 " ST-956-C........ 1 Verneuilina G45-5-110-C..... 1
56-58	1054-1060	146	55	Sh.,dk.gy., very hard, massive, with pyrite stringers, very sdy.,with crossbeds and lenses of lt.gy., f.g.,ss. and silt.		Nil
59	1060★★1062	152	49	Sh., as above, but with very little ss.	50%	Ammobaculites ST-930-A...... 2 Ammomarginulina ST-956-A.... 3 " ST-956-B.... 8 " undiff...... 17 Gaudryina SR-1018-A......... 1 Haplophragmoides undiff ★★★. 8 Trochammina ST-892-A........ 3 " ST-956-C ★...... 19 Verneuilina SR-1009-A....... 14 " G45-5-110-C..... 4

★ probably includes some young forms of T. ST-892-A.

★★ lower "acme" of Ammomarginulina ST-956-B
(Upper "acme" at 1011')

★★★ mostly of the H. ST-850-A type.

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content	
60	★★★★ 1062-1064	154	47	"	50%	Ammobaculites G45-5-110-A ?..	1
						Ammomarginulina ST-956-A.....	5
						" undiff.......	7
						Flabellammina SR-1013-A......	5
						Gaudryina SR-1018-A..........	1
						Haplophragmoides undiff......	4
						Spiroplectammina sp..........	2
						Trochammina ST-892-A.........	4
						" ST-956-C.........	3
						Verneuilina SR-1009-A........	1
						" G45-5-110-C......	1
61-64	1064-1072	156	45	Sh.,dk.gy.,very hard, massive, pyrite stringers; upper 5' is very sdy., with crossbeds and lenses of lt. gy.,f.g.,ss. and silt; the lower 3' is mainly sh., interbedded with many very thin bands of lt.gy. silt and a few 1" to 1½" bands of clay ironstone.		Nil	
	1069'	- Ostrea sp.					
	1073'	- Lingula sp.					
65	1072-1074	164	37	As in lower 3' of preceding interval.	70%	Ammomarginulina sp..........	1
						Trochammina ST-956-C........	1
						" ST-956-C ?......	2
						Trochammina undiff..........	8
						Verneuilininae unclassified.	5
						Ostracod unident.	
66	1074-1076.5	166	35	Sh.,dk.gy., hard, massive, pyrite stringers, sdy., with lenses of lt.gy.,f.g. ss. and silt; basal 8" is brownish-grey., slickensided shale.	50%	Haplophragmoides sp.........	1
						Tritaxia ? sp...............	2
						Trochammina sp..............	1

★★★★ acme of Ammomarginulina ST-956-A.

Core Sample	Depth	Footage below base of Pouce Coupe Sandstone Member Equivalent	Footage above base of Kaskapau Formation	Lithology	Estimated percentage of total specimens picked	Microfaunal Content
67-73	1076.5-1092	168.5	32.5	Sh.,lt.green, hard,massive, slickensided in places,with lenses and crossbeds of lt. gy.,f.g.ss. and silt; some lt.brown, hard sh.,with a little carb. material.		Nil
74-78	1092-1102	184	17	Sh.,dk.gy.,hard, massive, with many narrow bands and thin interbeds of lt.gy.,f.g.ss.and silt; some thin bands of ironstone.		Nil
	1102-1104	- Brachydontes sp, Corbula sp, Ostrea sp (Corbula sp. abundant)				
79	1102-1104	194	7	Sh., dk.gy.,very hard, massive,pyrite stringers.	50%	Ammomarginulina undiff...... 5 Flabellammina SR-1013-A..... 11 Haplophragmoides undiff..... 4 Trochammina ST-892-A........ 1 " ST-956-C........ 25 Ostracod unident.
80	1104-1106	196	5	Sh., as above, but becoming quite sdy. towards base with many lenses of greenish and brownish f.g.,glauc.ss.	20%	Ammomarginulina sp.......... 1 Flabellammina SR-1013-A..... 3 Trochammina ST-892-A........ 1 " ST-956-C........ 29
81-82	1106-1109	198	3	Sh. and ss., as above, inter and crossbedded; a few patches of ironstone.		Nil

1109' - Top of Dunvegan Formation

Ss., lt. gy., f.g., some glauc., a few thin lenses of dark grey shale.

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PART II

Dunvegan Localities

Section A: Foraminiferal Identifications in the Upper Cenomanian beds of the Imperial Oil Limited Surface Division Localities S47-27 and S47-28 near Dunvegan, Alberta.

Location: Tp.80 - Rge.5 W 6th Meridian, on north bank of the Peace River, 1 1/2 miles upstream from Dunvegan Ferry.

Field Party: Imperial Oil #16, summer of 1947.

Geologist in Charge: Dr. Charles R. Stelck, Department of Geology, University of Alberta, formerly of the Imperial Oil Limited, Surface Division.

Lithologic Description: by Dr. Charles R. Stelck.

Sampling Method: Select discontinuous. (Actual samples are from six inch beds spaced at intervals of four to ten feet.)

Remarks: These two localities have the same geographical position, with Loc. S47-27 embracing the beds above the "Spirit River" Sand Equivalent, and Loc. S47-28 the ones below the sand.

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Sample Footage	Lithology	Foraminifera Identified	
(Footage above ★ Top of "Spirit River" Sandstone Equivalent)	- Soil		
	6' - Sh., very sdy., with silty shale.		
13 ★★		Nil	
	6' - Sh., dk.gy., silty.		
7		Ammobaculites ST-747-A.......	4
		Haplophragmoides undiff......	5
	5' - Sh., silty becoming sdy. at base.		
2		Ammobaculites ST-745-A ?.....	1
		" ST-747-A.......	5
		" G45-19-0-A.......	7
		Flabellammina sp ★★★.........	2
		Flabellammina undiff.........	2
		Haplophragmoides ST-740-A....	4
		" ST-838-A....	1
		" ST-850-A....	5
		" G46-1-10-A....	1
		" undiff.......	7
		Reophax sp...................	2

"Spirit River" Ss. Equivalent

Sample Footage	Lithology	Foraminifera Identified	
(Footage below ★ Top of "Spirit River" Sandstone Equivalent)			
	5' - Ss., very soft, med. fine, with Arctica, ironstone streaks		
	4' - Sd. and Sh., intermixed and sdy. shale.		
9		Ammobaculites sp ★★★★........	1
		Haplophragmoides ST-850-A....	15
		" sp ★★★★★....	4
		" undiff......	20
	8' - Sh., very sdy., with ss. streaks.		
17		Nil	
	8' - Sh., very sdy.		
25		Nil	

★ above = Loc. S47-27; ★ below = Loc. S47-28

★★ Samples taken at base of lithologic units.

★★★ Flabellammina 36-17-B of Stelck.

★★★★ fragment of a large form.

★★★★★ H. 28-9-C of Stelck.

Section B: Foraminiferal Identifications in the Upper Cenomanian beds of the Imperial Oil Limited Surface Division Locality C47-9, near Dunvegan, Alberta.

Location:	Sec.8 - Tp.80 - Rge.4 W 6th Meridian on north bank of Peace River about 1/2 mile downstream from Dunvegan Ferry.
Field Party:	Imperial Oil #18, summer of 1947.
Geologist in Charge:	William L. Clemis, Petrofina Corporation, Calgary, Alberta, formerly of the Imperial Oil Limited, Surface Division.
Lithologic Description:	No detailed description available.
Sampling Method:	Spot samples taken at ten foot intervals.

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Depth in Sampled Section	Approx. Footage below "Spirit River" Ss. Equivalent	Footage above Kaskapau Fm.	Foraminifera Identified	
0	45	135	Gaudryina ST-876-A	6
			" SR-1018-A	1
			Haplophragmoides ST-850-A	1
			" undiff.	17
			Trochammina ST-812-A	1
			" ST-910-A	5
			Verneuilina SR-1009-A	8
10	55	125	Gaudryina ST-876-A	2
			" SR-1018-A	3
			Haplophragmoides ST-902-A	2
			" undiff.	10
			Trochammina ST-910-A	20
			" undiff.	8
			Verneuilina SR-1009-A	5
20	65	115	Ammomarginulina ST-956-B ?	1
			Haplophragmoides ST-850-A	2
			" ST-902-A	19
			" undiff.	12
			Trochammina ST-956-C	2
			Verneuilina SR-1009-A	5
			Radiolarian unident.	
25	70	110	Probable Base of Trochammina ST-910-A Subzone	
			Probable Base of Gaudryina ST-876-A Zone	
			Probable Top of Ammobaculites ST-930-A Zone	
30	75	105	Ammomarginulina ST-956-A ?	1
			Haplophragmoides undiff.	7
			Proteonina sp.	1
			Trochammina undiff.	2
40*	85	95	Ammobaculites ST-930-A	9
			Flabellammina SR-1013-A	1
			" C47-9-95-A	13
			" G45-5-105-B	1
			" G45-5-105-B ?	1
			Gaudryina ST-876-A ?	1
			" SR-1018-A	1
			Haplophragmoides ST-850-A	3
			" SR-1011-B ?	1
			" G45-5-85-A	2
			" undiff.	23
			Trochammina ST-956-C	13
58	103	77	Haplophragmoides ST-838-A	1
			" undiff.	3
			Spiroplectammina sp.	1
			Trochammina undiff.	3

* Acme of Ammobaculites ST-930-A.
" " Flabellammina C47-9-95-A.

PART III

Doe Creek Localities

Section A: Foraminiferal Identifications in the Upper Cenomanian beds of the Imperial Oil Limited Surface Division Locality G45-5, on Doe Creek, Alberta.

Location: Lsd.13 - Sec.10 - Tp.81 - Rge.13 - W 6th Meridian.

Field Party: Imperial Oil #13, summer of 1945.

Geologist in Charge: Joseph Gleddie

Lithologic Description: No detailed description available.

Megafossil Identification: By Dr. P.S. Warren, Chairman,
Department of Geology,
University of Alberta.

Sampling Method: Continuous trenching over five feet intervals.

Remarks: This locality is the same geographically as S47-4, but as different sampling methods were employed by the two parties, both sets of results are given. It would appear that use of the continuous trenching method yields a greater variety of forms than does the select discontinuous pattern.

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Depth in Sampled Section (Footage below base of Pouce Coupe Ss.)	Footage above base of Kaskapau Fm.	Foraminifera Identified	
0 - 5	260 - 265	Ammobaculites ST-930-A ?..........	2
		Flabellammina C47-9-95-A ?.........	2
		" G45-5-110-B.........	1
		Haplophragmoides ST-850-A.........	1
		" ST-902-A.........	2
		" sp................	1
5 - 10	255 - 260	Flabellammina sp..................	1
		Gaudryina ST-876-A ?..............	1
		Haplophragmoides ST-902-A.........	4
		" undiff...........	7
		Proteonina sp.....................	1
10 - 15	250 - 255	Flabellammina sp..................	1
		Haplophragmoides ST-902-A.........	3
		" undiff...........	4
		Trochammina sp....................	1
15	250	Dunveganoceras albertense, Inoceramus corpulentus	
15 - 20	245 - 250	Haplophragmoides undiff............	3
20 - 45	220 - 245	Negligible	
45 - 50	215 - 220	Flabellammina sp..................	1
		Haplophragmoides sp...............	1
50 - 55	210 - 215	Ammobaculites G45-5-110-A.........	2
		Flabellammina ST-937-A............	1
		" C47-9-95-A..........	1
		" undiff..............	5
		Haplophragmoides ST-958-A.........	1
		" undiff...........	4
		Proteonina sp.....................	1
		Textularia ? sp...................	2
		Trochammina ST-892-A..............	1
55 - 80	185 - 210	Nil	
80 - 85	180 - 185	Flabellammina G45-5-110-B.........	2
85 - 90★	175 - 180	Ammobaculites ST-930-A............	1
		Flabellammina SR-1013-A...........	1
		" C47-9-95-A ?........	1
		" G45-5-110-B.........	6
		Gaudryina ST-876-A................	5
		" SR-1018-A...............	2
		Haplophragmoides ST-958-A.........	1
		" SR-1011-B.........	1
		" G45-5-85-A........	8

(Continued)

★ Acme of Flabellammina G45-5-110-B.
" " Gaudryina ST-876-A.
" " Haplophragmoides G45-5-85-A.

Depth in Sampled Section (Footage below base of Pouce Coupe Ss.)	Footage above base of Kaskapau Fm.	Foraminifera Identified	
(Cont'd)			
85 - 90	175 - 180	Saccammina sp	1
		Textularia sp	1
		Trochammina ST-812-A	1
		" ST-956-C	1
		" S47-4-186-A	1
		" sp	1
90 - 95	170 - 175	Flabellammina sp	1
		Gaudryina ST-876-A ?	1
		Haplophragmoides undiff	3
95 - 100	165 - 170	Flabellammina sp	1
		Haplophragmoides undiff	2
		Trochammina undiff	3
100 - 105	160 - 165	Flabellammina ST-937-A	1
		" SR-1013-A	1
		Haplophragmoides G45-5-85-A	1
		" undiff	2
		Spirillina sp	1
		Trochammina ST-892-A	1
		" ST-956-C	2
		" S47-4-186-A	1
105 - 110*	155 - 160	Ammobaculites ST-930-A	10
		Ammomarginulina sp	1
		Flabellammina ST-937-A	3
		" G45-5-105-A	5
		" G45-5-105-B	5
		" G45-5-115-A	2
		Gaudryina ST-876-A	2
		Haplophragmoides SR-1011-B	1
		" G45-5-85-A	2
		" undiff	3
		Textularia sp	2
		Trochammina ST-956-C	10
		" S47-4-186-A	2
		" undiff	2
		Verneuilina SR-1009-A	3
110	155	Top of Trochammina ST-956-C Subzone	
110 - 115**	150 - 155	Ammobaculites ST-930-A	6
		" G45-5-110-A	4
		Ammomarginulina sp ***	1
		Flabellammina ST-937-A	3
		" SR-1013-A	1
		" G45-5-105-B	2

Acme of Ammobaculites ST-930-A
* " " Flabellammina G45-5-105-A
" " " G45-5-105-B
" " " ST-937-A

** Acme of Ammobaculites G45-5-110-A
" " Verneuilina G45-5-110-C

*** Ammobaculites ? 4-196-C of Stelck.

(Continued)

Depth in Sampled Section (Footage below base of Pouce Coupe Ss.)	Footage above base of Kaskapau Fm.	Foraminifera Identified	
(Cont'd)			
110 - 115	150 - 155	Flabellammina G45-5-110-B	1
		Gaudryina ST-876-A	3
		" SR-1018-A	1
		Haplophragmoides ST-958-A	2
		" G45-5-85-A	2
		" undiff.	3
		Trochammina ST-892-A	2
		" ST-956-C	8
		Verneuilina SR-1009-A	1
		" G45-5-110-C	4
115 - 120★	145 - 150	Ammobaculites ST-930-A	5
		Flabellammina G45-5-105-A	1
		" G45-5-110-B	1
		" G45-5-115-A	6
		Gaudryina ST-876-A	1
		" SR-1018-A	1
		Trochammina ST-956-C	7
		" sp.	1
		Verneuilina G45-5-110-C	1
120 - 125	140 - 145	Ammobaculites ST-930-A	3
		" G45-5-110-A	1
		Flabellammina G45-5-105-B	1
		Gaudryina ST-876-A	1
		Haplophragmoides G45-5-85-A	1
125 - 130	135 - 140	Ammobaculites ST-930-A	1
		Flabellammina sp.	1
		Haplophragmoides sp.	1
130 - 160	105 - 135	Nil	
145 approx.	120	- *Brachydontes multilinigera*, *Ostrea sp*	
160 - 165	100 - 105	Ammobaculites ST-930-A	1
		Ammomarginulina sp.	1
165 - 170	95 - 100	Ammobaculites ST-930-A	8
		Ammomarginulina sp.	2
		Flabellammina ST-937-A	3
		" SR-1013-A	7
		" C47-9-95-A ?	2
		" G45-5-110-B	1
		Gaudryina ST-876-A	4
		" SR-1018-A	1
		Haplophragmoides ST-902-A	1
		" G45-5-85-A	1
		" sp.	1
		Trochammina ST-956-C	3
		" S47-4-186-A	3

★ Acme of Flabellammina G45-5-115-A.

Depth in Sampled Section (Footage below base of Pouce Coupe Ss.)	Footage above base of Kaskapau Fm.	Foraminifera Identified	
170 - 175	90 - 95	Haplophragmoides sp..................	1
		Trochammina sp......................	1
175 - 180	85 - 90	Haplophragmoides SR-1018-B.........	1
180 - 185★	80 - 85	Ammobaculites ST-930-A.............	8
		Ammomarginulina ST-956-A ?.........	1
		" ST-956-B...........	4
		" sp ★★.............	2
		" sp ★★★............	2
		Flabellammina SR-1013-A............	3
		" G45-5-105-A..........	1
		Gaudryina SR-1018-A................	2
		Haplophragmoides SR-1018-B.........	1
		" undiff ★★★★.......	12
		Textularia G45-5-220-A.............	2
		Trochammina ST-892-A...............	2
		" ST-956-C...............	3
		Verneuilina SR-1009-A..............	1
185 - 205	60 - 80	Nil	
205 - 210	55 - 60	Ammobaculites sp...................	1
		Trochammina ST-956-C...............	1
210 - 215	50 - 55	Trochammina undiff.................	2
215 - 220	45 - 50	Trochammina sp.....................	1
220 - 225	40 - 45	Flabellammina G45-5-105-A..........	3
		Textularia G45-5-220-A.............	2
		Trochammina ST-892-A...............	1
		" ST-956-C...............	13
		" S47-4-186-A............	2
		" undiff.................	4

★ Acme of Ammomarginulina ST-956-B.
★★ Ammobaculites ? 4-196-C of Stelck.
★★★ a rather small sharply angular form.
★★★★ mainly of the H. ST-850-A type.

Section B: Foraminiferal Identifications in the
Upper Cenomanian Beds of the
Imperial Oil Limited Surface Division
Locality S47-4, on Doe Creek, Alberta.

Location: Tp. 81 - Rge.13- W 6th Meridian.
Doe Creek canyon at the northernmost point of the big bend, east of Doe River P.O., British Columbia.
Section itself is in Alberta.

Field Party: Imperial Oil #16, summer of 1947.

Geologist in Charge: Dr. Charles R. Stelck.

Lithologic Description: by Dr. Charles R. Stelck.

Sampling Method: Select discontinuous
(Actual samples are from six inch beds spaced at intervals of four to ten feet)

Remarks: This locality is the same geographically as G45-5, but as different sampling methods were employed by the two parties, both sets of results are given. It would appear that use of the select discontinuous method does not produce such a wide variety of forms as does the continuous trenching method, although no important horizons are missed, and in some cases, more individual specimens are recovered by the former method.

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Depth of Sample Footage below base Pouce Coupe Ss.	Footage above base of Kaskapau Fm.	Lithology	Foraminifera Identified
0	268	Base of cliff-forming Pouce Coupe Ss., massive, f.g., clean.	-----
		3'-Ss.,shy.,gy.,argill.	
		9'-Ss.,argill.,grading downward into sdy.shales,interstreaked with ss.	
12★	256		Trochammina sp............... 1 Verneuilina sp............... 1
		4'-Sh., sdy.	
		2'-Siltstone, sdy.	
		1'-Ironstone nodules.	
		5'-Sh.,sdy.,with ss.as streaks and worm burrows.	
24★★	244		Haplophragmoides ST-902-A.... 3
		2'6"-Sh., as above	
		6"-Ironstone	
		1'8"-Sh.,silty and sdy.	
		1"-Ironstone, nodular band.	
		1'6"-Siltstone, argill.,sdy.	
30	238		Nil
		7'-Siltstones, thin, argill., interbedded with shy., argill. ss.	
		2"-Ss.,fine, dk., argill.	
		1'-Sh., very silty.	
37	231		Ammomarginulina sp........... 1 Verneuilina sp............... 1
		5'-Sh., silty.	
		6"-Ironstone nodules.	
		2'6"-Sh., silty, slightly sdy.	
46	222		Haplophragmoides ST-902-A.... 1 Verneuilina sp............... 1
		9'-Sh.,silty, slightly sdy. at top.	
55	213		Ammobaculites ST-930-A ?..... 1 Haplophragmoides G45-5-85-A.. 1 Textularia sp................ 1 Trochammina ST-956-C......... 2
		6'-Sh., silty.	
61	207		Bathysiphon sp............... 1 Haplophragmoides sp.......... 1

★ Sample taken at base of lithologic unit.

★★ Acme of Haplophragmoides ST-902-A.

Depth of Sample Footage below base of Pouce Coupe Ss.)	Footage above base of Kaskapau Fm.	Lithology	Foraminifera Identified	
		1'-Sh., silty.		
		2"-Ss., ferrug.		
		1'6"-Siltstones and Ss.'s. interbedded.		
		6'6"-Ss.,med.fine to med.		
		2'-Sh.,bl.,with small 1" lenticles of Ss.		
		3'-Sh.		
74	194		Ammobaculites ST-930-A......	2
			Flabellammina SR-1013-A.....	1
			Haplophragmoides ST-958-A...	1
			" undiff.....	3
			Trochammina ST-892-A........	1
			Verneuilina SR-1009-A.......	1
		6"-Ss.,ferrug., with worm borings to 1/4" diam.		
		4'-Ss.(Top of Doe Creek Member) yellow,f.g.,with ferrug.bands.		
		1'-Ss.,f.g.,argill.,inter-crossbedded with med.fine, shy.ss.		
		2"-Sh.,soft, bl., with small lenses of ss.		
		4"-Ss.,soft, argill.		
		4"-Ss.,ferrug., concret. (Base of Doe Creek Member)		
		4'-Sh.,sdy., and argill.ss., intermixed.		
		8"-Ironstone,sdy., as concret. nodules in argill. ss.		
		6'6"-Sh.,very sdy.,grading up into argill. ss.		
		1'-Sh., finely sdy.		
93	175		Haplophragmoides G45-5-85-A..	1
		3'6"-Sh.,silty to finely sdy.		
97	171		Ammobaculites ST-930-A......	4
			Flabellammina G45-5-105-B....	2
			Haplophragmoides ST-902-A...	1
			" G45-5-85-A..	1
			Textularia G45-5-220-A......	1
			Trochammina ST-956-C........	3
		2'-Sh., silty.		
		3'6"-Ss.,soft, argill., shy.,with some sdy. sh. intermixed.		
		3'-Sh.,sdy.,with ss.streaks.		
		2'-Siltstone, argill.,with ironstone nodules.		
		6"-Ironstone, in irregular nodular bands.		
		6"-Siltstone.		
		3'-Sh., sdy., glauc.		
112	156		Flabellammina G45-5-110-B ?.	1
			Trochammina ST-956-C........	1

Depth of Sample Footage below base of Pouce Coupe Ss.)	Footage above base of Kaskapau Fm.	Lithology	Foraminifera Identified	
		1'6"-Sh., silty, slightly sdy. 6"-Siltstone. 4"-Ironstone. 4'6"-Sh., silty, slightly sdy., glauc.		
119	149		Ammobaculites ST-930-A......	1
			Ammomarginulina sp ★........	1
			Flabellammina ST-937-A......	1
			" SR-1013-A......	1
			Gaudryina SR-1018-A.........	1
			Trochammina ST-892-A........	1
			" ST-956-C........	1
			Verneuilina SR-1009-A.......	1
		6'-Sh.,silty,slightly sdy., glauc.		
125★★	143		Ammobaculites ST-930-A......	6
			Flabellammina G45-5-105-B...	1
			" undiff........	2
			Trochammina ST-956-C........	3
		1'-Siltstone, argill., shy. 3'6"-Sh., silty.		
129★★★	139		Ammobaculites ST-930-A......	6
			Flabellammina G45-5-105-A...	2
			Gaudryina SR-1018-A.........	6
			Haplophragmoides undiff.....	10
			Trochammina ST-956-C........	1
			Verneuilina SR-1009-A.......	1
			" G45-5-110-C.....	1
		2'-Siltstone, argill.,shy. 3'-Sh., silty.		
134	134		Ammobaculites ST-930-A......	1
			Flabellammina undiff........	2
			Gaudryina SR-1018-A.........	1
			Haplophragmoides undiff.....	5
			Trochammina ST-956-C........	1
			Verneuilina G45-5-110-C.....	2
		3'-Sh., silty. 4"-Ironstone nodules. 6"-Sh., sdy. 4"-Ironstone nodules. 6"-Siltstone, sdy. 1'-Sh., silty.		
140	128		Ammobaculites ST-930-A......	4
			Flabellammina G45-5-105-B...	1
			Gaudryina ST-876-A..........	1
			" SR-1018-A.........	1
			Haplophragmoides ST-958-A...	1
			" G45-5-85-A..	2
			" undiff......	3
			Tritaxia ST-664-B...........	1
			Trochammina ST-956-C........	11
			Verneuilina SR-1009-A.......	2

★ Ammobaculites ? 4-196-C of Stelck.

★★ Acme of Ammobaculites ST-930-A.

★★★ Acme of Gaudryina SR-1018-A.

Depth of Sample Footage below base of Pouce Coupe Ss.	Footage above base of Kaskapau Fm.	Lithology	Foraminifera Identified	
		3'-Sh., somewhat silty.		
		2'-Ss., lenticular, with ironstone and shy.content.		
		7'6"-Ss., soft, argill., shy.with sdy.concrets. at top. Oysters		
		6"-Ironstone.		
		7'-Sh.,sdy.,with sd.filled worm borings and small sdy.lenticles.		
		4'-Sh., slightly sdy.		
162	106		Ammobaculites G45-5-110-A...	1
			Flabellammina G45-5-105-A...	1
			Haplophragmoides undiff.....	12
			Proteonina SR-1034-A ?......	1
			Trochammina ST-956-C........	6
			Verneuilina SR-1009-A ?.....	2
			" G45-5-110-C......	1
		4"-Ss.,brown nodular.		
		3'-Ss., thin bedded,mic., carb., finely crossbedded, interlensing with siltstone.		
		1'-Siltstones, argill.,interbedded with fine, argill. ss. lenticles.		
		4'-Sh.,sdy.,with siltstones and very fine ss.		
		1'-Sh., silty.		
172	96		Ammobaculites ST-930-A......	3
			Haplophragmoides undiff.....	7
			Spirillina sp...............	1
			Trochammina ST-956-C........	6
			Verneuilina G45-5-110-C.....	2
		1'-Sh.,slightly sdy.		
		3'-Sh., sdy.		
		6"-Sh., sdy., with occasional ironstone.		
		1'6"-Sh., silty.		
		2"-Ss., fine, cal.		
		1'-Sh., silty.		
		1'-Sh.		
180	88		Ammobaculites ST-930-A......	2
			Ammomarginulina sp..........	1
			Flabellammina SR-1013-A.....	2
			" G45-5-105-B....	1
			Haplophragmoides undiff.....	7
			Trochammina ST-892-A........	3
			" ST-956-C........	2
			" S47-4-186-A......	2

Depth of Sample (Footage below base of Pouce Coupe Ss.)	Footage above base of Kaskapau Fm.	Lithology	Foraminifera Identified	
		4'-Sh., silty.		
		2'-Sh., bl.		
186*	82		Ammobaculites ST-930-A.....	5
			Flabellammina SR-1013-A....	6
			" G45-5-105-A...	2
			" G45-5-105-B...	1
			" G45-5-110-B ?.	1
			Gaudryina ST-876-A.........	5
			" SR-1018-A........	4
			Haplophragmoides SR-1011-B..	1
			" G45-5-85-A..	2
			" undiff.....	13
			Trochammina ST-892-A.......	7
			" ST-956-C.......	6
			" S47-4-186-A.....	14
			" undiff..........	8
			Verneuilina SR-1009-A......	3
			" G45-5-110-C.....	2
		1'-Ss.,soft, argill.,shy.		
		2"-Ironstone, nodular,band.		
		2"-Siltstone.		
		1'-Ironstone and Siltstone, as lenses.		
		3'6"-Siltstone, gy., with 30% argill., thin ss.		
		4'-Siltstone, gy.,with 30% sdy.sh.interbedded.		
		2'-Sh., dk. gy.		
196**	72		Ammomarginulina ST-956-B...	5
			" sp ***.....	5
			Flabellammina SR-1013-A....	2
			" sp...........	1
			Haplophragmoides undiff****	12
			Verneuilina SR-1009-A......	1
		1"-Ironstone band.		
		4'-Sh., slightly silty.		
201	67		Ammobaculites ST-930-A.....	1
			Ammomarginulina ST-956-B...	5
			" sp.........	1
			Flabellammina undiff.......	2
			Gaudryina ST-876-A.........	1
			" SR-1018-A........	1
			Haplophragmoides SR-1018-B..	1
			" undiff****.	30
			Trochammina S47-4-186-A....	2
			Verneuilina SR-1009-A......	1

* Acme of Trochammina S47-4-186-A

** Acme of Ammomarginulina ST-956-B

*** Ammobaculites ? 4-196-C of Stelck.

**** mainly of the H. ST-850-A type.

Depth of Sample (Footage below base of Pouce Coupe Ss.)	Footage above base of Kaskapau Fm.	Lithology	Foraminifera Identified	
		2'-Sh.,slightly silty.		
		3"-Ironstone.		
		5'-Sh., sdy.		
		6"-Ironstone		
		6"-Siltstone, sdy.		
		6"-Ss., ferrug.,argill.,shy.		
		1'-Ss.,soft, shy., argill.		
		3'-Sh.,sdy, with 30% ss., in the form of worm borings,thin lenses and streaks.		
		3'-Sh., sdy.		
		1'-Ironstone nodules.		
		7'6"-Ss., shy.,argill., with admixture of sdy.sh.		
		1'-Ss., soft, argill.		
		3'-Sh., sdy.		
		1'-Sh., sdy.,with ferrug. concrets. at top.		
		2'6"-Sh., bl.,silty,with 5% ss. content.		
233	35		Trochammina S47-4-186-A....	1
		6"-Sh., sdy.		
		6"-Sh., sdy., with irregular ferrug.concrets.		
		2'6"-Siltstone,shy., argill.		
		6"-Sh., sdy.		
		6"-Ironstone.		
		2'-Sh., sdy.		
		½"-Ironstone.		
		1"-Sh.,bl.,fissile,silty.		
		6"-Sh.		
		2"-Ironstone, band.		
		1'-Sh.,flaky, silty.		
242	26		Trochammina S47-4-186-A....	1
		5'-Sh.,flaky, silty.		
247	21		Ammobaculites sp...........	1
			Ammomarginulina sp.........	1
			Trochammina ST-956-C.......	4
			Verneuilina G45-5-110-C....	1
		5'-Sh., flaky, silty.		
252	16		Nil	
		1'-Sh., flaky, silty.		
		3"-Ironstone.		
		3'-Sh., fissile, silty.		
256	12		Nil	

Depth of Sample (Footage below base of Pouce Coupe Ss.)	Footage above base of Kaskapau Fm.	Lithology	Foraminifera Identified
		½"-Ironstone.	
		1'-Siltstone, shaly, laminated.	
		½"-Ironstone.	
		6"-Siltstone, fine, argill.	
		2'6"-Sh., sdy.	
		6"-Sh., bl., silty.	
		6"-Ironstone, sdy., nodules in sdy. sh.	
		2'6"-Sh., silty, carb.	
		6"-Sh.,bl., with coaly streaks.	
		1"-Ironstone.	
		6"-Sh.,dk.gy., silty.	
264	4		Nil
		4'-Sh., dk.gy., silty.	
		3'-Ss. of Dunvegan Fm.proper, argill.,gy.,f.g.,crossbedded with carb. material.	

- Base of section - creek level

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PART IV

Pouce Coupe River Localities

Section A: Foraminiferal Identifications in the Uppermost Cenomanian beds of the Imperial Oil Limited Surface Division Localities G45-6 and G45-19 on the Pouce Coupe River, Alberta and British Columbia.

Location (G45-6): Lsd.11 - Sec.12 - Tp.79 - Rge.14- W 6th Meridian, on the west bank of the Pouce Coupe River, British Columbia.

Location (G45-19): Lsd.8 - Sec.4 - Tp.80 - Rge.13 - W 6th Meridian, on the east bank of the Pouce Coupe River, Alberta.

Field Party: Imperial Oil #13, summer of 1945.

Geologist in Charge: Joseph Gleddie.

Lithologic Description: No detailed description available.

Megafossil Identification: By Dr. P. S. Warren.

Sampling Method: Continuous trenching over five feet intervals.

Remarks: For a continuous reading of the microfaunal content of this part of the Kaskapau, the identifications made at Loc. G45-19 are attached to the end of those made at Loc. G45-6.

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[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

- LOCALITY G45-6 -

Depth in Sampled Section	Projected Footage above Pouce Coupe Ss.	Foraminifera Identified	
0 - 5	55 - 60	Ammobaculites undiff ★..............	2
		Haplophragmoides sp.................	2
		Trochammina sp......................	2
5 - 10	50 - 55	Ammobaculites ST-747-A..............	6
		" undiff ★★..............	3
		" undiff ★..............	3
		Haplophragmoides G45-3-90-A.........	2
		Trochammina sp......................	1
10 - 15	45 - 50	Ammobaculites ST-747-A..............	6
		" undiff ★..............	4
		Haplophragmoides undiff.............	2
15 - 20	40 - 45	Ammobaculites ST-745-A..............	1
		" ST-747-A..............	4
		" undiff ★..............	3
		Haplophragmoides sp.................	1
20 - 25	35 - 40	Ammobaculites ST-745-A..............	1
		" ST-747-A..............	2
25 - 40	20 - 35	Nil	
40 - 45	15 - 20	Ammobaculites sp ★★★................	1
		Haplophragmoides G46-1-10-A.........	11
		" undiff.............	15
		Spiroplectammina ST-838-B...........	1
		Tritaxia ST-664-B...................	3
		Trochammina S47-4-186-A.............	1

. . . .

★ fragments of large forms.

★★ probably A. ST-747-A.

★★★ a large form.

[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

- LOCALITY G45-19 -

Depth in Sampled Section	Footage above Pouce Coupe Ss.	Foraminifera Identified	
0 - 5	10 - 15	Haplophragmoides SR-1011-B..........	1
		" G46-1-10-A.........	3
		" undiff.............	7
		Spiroplectammina ST-838-B..........	2
5 - 10	5 - 10	Haplophragmoides undiff............	2
10 - 15	0 - 5	Ammobaculites ST-747-A.............	2
		" G45-19-0-A...........	7
		Spiroplectammina ST-838-B..........	4
		Trochammina sp.....................	2

Pouce Coupe Sandstone
carrying Dunveganoceras poucecoupense

Near the top of the shale section underlying the Pouce Coupe Ss., the following pelecypods have been identified: -

Inoceramus corpulentus
Arctica murrayensis
Dunveganoceras albertense

. . . .

Section B: Foraminiferal Identifications in the Upper Cenomanian beds of the Imperial Oil Limited Surface Division Locality G45-18 on the Pouce Coupe River, Alberta.

Location: Lsd.2 - Sec.15 - Tp.80 - Rge.13 - W 6th Meridian.

Field Party: Imperial Oil #13, summer of 1945.

Geologist in Charge: Joseph Gleddie.

Lithologic Description: No detailed description available.

Sampling Method: Continuous trenching over five feet intervals.

. . . .

Depth in Sampled Section	Footage above base of Kaskapau Fm.	Foraminifera Identified	
0 - 5	47 - 52	Nil	
5 - 10	42 - 47	Ammobaculites sp....................	1
		Ammomarginulina sp..................	1
		Trochammina ST-956-C................	3
		" undiff.................	2
10 - 45	7 - 42	Nil	
45 - 50	2 - 7	Ammobaculites undiff................	3
		Flabellammina C47-9-95-A............	1
		Haplophragmoides sp.................	1
		Trochammina ST-892-A................	5
		" ST-956-C................	3
50 - 52	0 - 2	Nil	

Top of Dunvegan Formation

. . . .

- [illegible] -

[illegible]	[illegible]	[illegible]
[illegible]	[illegible] — [illegible]	[illegible] —
[illegible] .... [illegible]	[illegible] — [illegible]	[illegible] —
[illegible]	[illegible] — [illegible]	[illegible] — [illegible]
[illegible]	[illegible] — [illegible]	[illegible] — [illegible]
[illegible] .... [illegible]		
[illegible]	[illegible] — [illegible]	[illegible] —

[illegible]

PART V

Henderson Creek Localities

Foraminiferal Identifications in the beds of the Imperial Oil Limited Surface Division Localities G45-3 and G45-4 on Henderson Creek, Alberta.

Location (G45-3):	Lsd.12 - Sec.15 - Tp.79 - Rge.13 - W 6th Meridian on Henderson Creek.
Location (G45-4):	Lsd.3 - Sec.16 - Tp.79 - Rge.13 - W 6th Meridian on Henderson Creek.
Field Party:	Imperial Oil #13, summer of 1945.

Geologist in Charge: Joseph Gleddie.

Lithologic Description: No detailed description available.

Megafossil Identification: by Dr. P.S. Warren.

Sampling Method: Continuous trenching over five feet intervals.

Remarks: In order to maintain stratigraphic continuity of microfaunal content, Loc. G45-4 is joined to the base of Loc. G45-3.

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Depth in Sampled Section	Footage above White Chalcedonic Bed	Projected Footage above Pouce Coupe Ss.	Foraminifera Identified	
0 - 5*	145 - 150	345 - 350	Flabellammina G45-3-145-A........	4
			Haplophragmoides G46-1-10-A......	3
			" G45-3-80-A.....	1
			" G45-3-145-B....	3
			" undiff.........	5
			Trochammina ST-658-A............	2
			" sp..................	1
5 - 10**	140 - 145	340 - 345	Flabellammina G45-3-145-A........	39
			" sp................	2
			Haplophragmoides G46-1-10-A.....	9
			" G45-3-80-A.....	4
			" G45-3-145-B....	7
			Trochammina ST-658-A............	6
			" sp..................	3
10 - 15	135 - 140	335 - 340	Flabellammina G45-3-145-A.......	7
			" undiff............	5
			Haplophragmoides G46-1-10-A......	2
			" G45-3-80-A.....	1
			Trochammina ST-658-A............	1
			" sp..................	2
15'	Apparent Base of Trochammina ST-658-A Subzone			
15 - 20	130 - 135	330 - 335	Flabellammina undiff............	4
			Haplophragmoides undiff.........	3
20 - 25	125 - 130	325 - 330	Nil	
25 - 30	120 - 125	320 - 325	Haplophragmoides G46-1-10-A.....	3
			" G45-3-80-A.....	5
			Proteonina ? sp.................	1
30 - 55	95 - 120	295 - 320	Nil	
30' approx.	120	295	Inoceramus labiatus	
55 - 60	90 - 95	290 - 295	Ammobaculites sp................	1
			Flabellammina G45-3-145-A.......	3
			Haplophragmoides G46-1-10-A.....	1
			" G45-3-80-A.....	2
			" G45-3-90-A.....	2
60 - 65	85 - 90	285 - 290	Ammobaculites sp................	1
			Haplophragmoides G46-1-10-A.....	5
			" G45-3-90-A.....	11
65 - 70	80 - 85	280 - 285	Flabellammina sp................	1
			Haplophragmoides G46-1-10-A.....	14
			" G45-3-80-A.....	6
			" G45-3-90-A.....	4
			" G45-3-145-B....	1
			Tritaxia ST-664-B...............	1

* Inoceramus sp and Watinoceras sp were collected at a footage of approximately 20' above the top of this sampled section.

** Probable Acme of Flabellammina G45-3-145-A.

Depth in Sampled Section	Footage above White Chalcedonic Bed	Projected Footage above Pouce Coupe Ss.	Foraminifera Identified	
70 - 75	75 - 80	275 - 280	Ammobaculites sp.	1
			Flabellammina G45-3-145-A	3
			Haplophragmoides G46-1-10-A	8
			" G45-3-80-A	7
			" G45-3-90-A	1
			" G45-4-55-A	3
			" S47-35-6-A	1
			Tritaxia ST-664-B	3
75 - 80	70 - 75	270 - 275	Haplophragmoides G46-1-10-A	1
			" G45-3-80-A	1
80 - 85	65 - 70	265 - 270	Haplophragmoides G45-3-80-A	1
85 - 90	60 - 65	260 - 265	Ammobaculites sp.	1
			Flabellammina G45-3-50-A	2
			" sp.	1
			Haplophragmoides G46-1-10-A	8
90 - 95	55 - 60	255 - 260	Ammobaculites undiff.	7
			Flabellammina G45-3-50-A	4
			" G45-3-145-A	2
			" undiff.	4
			Haplophragmoides G46-1-10-A	11
			" G45-3-80-A	1
			" G45-3-90-A	1
			" G45-4-55-A	2
			Proteonina sp.	1
			Tritaxia ST-664-B	2
95 - 100	50 - 55	250 - 255	Ammobaculites ST-747-A	3
			Flabellammina G45-3-145-A	1
			" undiff.	2
			Haplophragmoides G45-4-55-A	1
			" undiff.	3
			Tritaxia ST-664-B	2
			Trochammina sp.	1
100 - 105	45 - 50	245 - 250	Flabellammina G45-3-50-A	3
			" G45-3-145-A	4
			Haplophragmoides G46-1-10-A	8
			" G45-3-90-A	1
105 - 110	40 - 45	240 - 245	Haplophragmoides G46-1-10-A ★	13
			Tritaxia ST-664-B	1
			Trochammina sp.	1
110 - 115	35 - 40	235 - 240	Flabellammina G45-3-145-A ?	1
			Haplophragmoides undiff.	3
115 - 120	30 - 35	230 - 235	Flabellammina G45-3-145-A	4
			" G45-3-50-A	1
			Haplophragmoides G46-1-10-A	2
			" G45-3-80-A	1
			" G45-3-90-A	9

★ may include some specimens of H. G45-3-90-A.

Depth in Sampled Section	Footage above White Chalcedonic Bed	Projected Footage above Pouce Coupe Ss.	Foraminifera Identified	
120 - 135	15 - 30	215 - 230	Nil	
130 approx.	25 -	225 -	Inoceramus cf. labiatus, Placenticeras pseudoplacanta, Oxytoma, Turritella	
135 - 140	10 - 15	210 - 215	Haplophragmoides sp............	2
140 - 145	5 - 10	205 - 210	Flabellammina G45-3-145-A...... " undiff........... Haplophragmoides sp............	2 5 1
145 - 150	0 - 5	200 - 205	Ammobaculites sp............... Flabellammina G45-3-50-A....... " undiff........... Haplophragmoides undiff........	2 4 3 4
150 - 155	-------	195 - 200	White Chalcedonic Bed	
	Footage below White Chalcedonic Bed			
155 - 160	0 - 5	190 - 195	Nil	
160 - 165	5 - 10	185 - 190	Flabellammina G45-3-145-A...... " G45-3-50-A....... " sp............... Haplophragmoides G46-1-10-A.... " undiff........	4 2 1 3 2
165 - 170	10 - 15	180 - 185	Ammobaculites sp*.............. Flabellammina G45-3-50-A.......	2 1
170 - 175	15 - 20	175 - 180	Ammobaculites sp............... Flabellammina sp...............	1 2
175 - 180	20 - 25	170 - 175	Flabellammina G45-3-50-A....... " sp............... Haplophragmoides sp............	2 2 2
180 - 185	25 - 30	165 - 170	Flabellammina G45-3-50-A....... " sp............... Haplophragmoides sp............ Tritaxia ST-664-B..............	2 2 2 1

. . . .

* a rather large form.

- LOCALITY G45-4 -

Depth in Sampled Section	Footage below White Chalcedonic Bed	Projected Footage above Pouce Coupe Ss.	Foraminifera Identified	
0 - 5	30 - 35	160 - 165	Ammobaculites sp...............	1
			Flabellammina undiff...........	4
			Haplophragmoides G46-1-10-A....	1
			" G45-3-80-A....	2
5 - 10	35 - 40	155 - 160	Ammobaculites undiff...........	2
			Flabellammina G45-3-50-A.......	1
			" undiff...........	2
			Haplophragmoides G46-1-10-A....	2
			" G45-3-80-A....	1
			" S47-35-6-A....	1
			Tritaxia ST-664-B..............	2
10 - 15	40 - 45	150 - 155	Ammobaculites sp...............	1
			Flabellammina G45-3-145-A......	2
			" undiff...........	3
			Haplophragmoides G46-1-10-A....	2
			Tritaxia ST-664-B..............	1
15	45	150 -	Possible top of Ammobaculites ST-747-A Zone and Position of Cenomanian - Turonian Boundary	
15 - 20	45 - 50	145 - 150	Ammobaculites undiff *.........	2
			Flabellammina G45-3-145-A......	1
			" undiff...........	2
			Haplophragmoides G46-1-10-A....	5
			" G45-3-90-A....	1
			Tritaxia ST-664-B..............	1
20 - 25	50 - 55	140 - 145	Ammobaculites ST-747-A.........	2
			" sp...............	1
			Haplophragmoides G46-1-10-A....	8
			Tritaxia ST-664-B..............	2
25 - 30	55 - 60	135 - 140	Ammobaculites ST-747-A.........	7
			" sp **............	4
			Haplophragmoides G45-3-90-A....	1
			" G45-4-55-A....	16
			Reophax sp.....................	1
			Tritaxia ST-664-B..............	1

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* A. ST-745-A or 747-A.

** probably A. ST-747-A.

PART VI

Kiskatinaw River Localities

Foraminiferal Identifications in the beds of the Imperial Oil Limited Surface Division Localities S47-35 and S47-36 on the Kiskatinaw River, British Columbia

Location: Tp.78 - Rge.17 W 6th Meridian, on the west bank of the Kiskatinaw River, one mile downstream from Arras, British Columbia.

Field Party: Imperial Oil #16, summer of 1947.

Geologist in Charge: Dr. Charles R. Stelck.

Lithologic Description: by Dr. Charles R. Stelck.

Sampling Method: Select discontinuous.
(Actual samples are from six inch beds spaced at intervals of four to ten feet)

Remarks: These two localities have the same geographical position, with Loc. S47-35 embracing the beds above the White Chalcedonic Bed, and Loc. S47-36 the ones below this bed.

. . . .

Sample footage (Footage above★ White Chalcedonic Bed	Footage above Pouce Coupe Ss.	Lithology	Foraminifera Identified	
		Overburden		
49	194		Nil	
		6'-Sh., silty		
43 ★★	188		Nil	
		7'-Sh., silty with occasional siltstone streak.		
36	181		Nil	
		6'-Sh., silty with 20% thin ss. lenticles.		
30	175		Nil	
		6'-Sh., as above.		
24	169		Nil	
		6'-Sh., as above.		
18	163		Nil	
		6'-Sh., as above.		
12	157		Flabellammina undiff.........	4
			Haplophragmoides G46-1-10-A..	3
			" S47-35-6-A...	7
			Textularia G45-5-220-A.......	1
			Verneuilina sp...............	1
		6'-Sh., as above.		
6 ★★★	151		Haplophragmoides G46-1-10-A..	5
			" G45-3-90-A..	2
			" S47-35-6-A..	10
			" undiff......	3
		6'-Sh., as above.		
1	146		Nil	
		7"-Ss., tuffaceous with white chalcedonic nodules.		

. . . .

★ Loc. S47-35

★★ samples taken at bases of lithologic units.

★★★ Acme of Haplophragmoides S47-35-6-A.

Sample footage (Footage below* White Chalcedonic Bed	Footage above Pouce Coupe Ss.	Lithology	Foraminifera Identified	
		6'-Sh., silty, with occasional ironstone and thin,very fine ss. lenticles.		
6	138		Flabellammina G45-3-145-A....	1
			Haplophragmoides G46-1-10-A..	11
			" G45-3-90-A..	1
			Textularia sp...............	1
		6'-Sh., as above.		
12	132		Haplophragmoides G46-1-10-A..	2
		5'-Sh., as above.		
17	127		Ammobaculites sp.............	1
			Flabellammina G45-3-145-A....	4
			" sp **.........	2
			Haplophragmoides G46-1-10-A***	19
			" G45-3-90-A..	1
		4'-Sh., silty.		
21	123		Flabellammina sp.............	1
		5'-Sh., as above.		
26	118		Haplophragmoides sp..........	1
		6'-Sh., as above.		
32	112		Flabellammina G45-3-145-A....	1
			Haplophragmoides undiff......	2
		4'-Sh.,silty, with one inch thick lenticles of ss. and silty ironstone.		
36	108		Flabellammina sp.............	1
			Haplophragmoides G46-1-10-A..	2
		5'-Sh., as above.		
41	103		Flabellammina sp.............	1
			Haplophragmoides G46-1-10-A..	1
			" undiff......	2
		5'-Sh., as above.		
46	98		Haplophragmoides G46-1-10-A..	1
			" G45-4-55-A..	1
		3'-Sh., as above.		
		½"-Tuff bed, rusty, hard.		
		1'-Sh., silty, with sd. lenticles and thin siltstone streaks.		
50	94		Haplophragmoides G46-1-10-A..	9
			" G45-3-90-A..	1
		5'-Sh., as above.		
55	89		Flabellammina sp.............	1
			Haplophragmoides G46-1-10-A..	1
			" G45-3-80-A..	1
		4'-Sh.,silty,with occasional thin fine ss.lenticles.		
59	85		Nil	

* Loc. S47-36.

** Flabellammina 36-17-B of Stelck.

*** probably includes some specimens of H. G45-3-80-A and G45-3-90-A.

Sample footage (Footage below* White Chalcedonic Bed	Footage above Pouce Coupe Ss.	Lithology	Foraminifera Identified	
		4'-Sh., silty as above.		
63	81		Nil	
		4'-Sh., silty, as above.		
67	77		Ammobaculites sp.	1
			Flabellammina G45-3-50-A	1
			" undiff.	2
			Haplophragmoides G46-1-10-A	1
			" undiff.	2
		4'-Ss., very fine, thin bedded with 30% sh.		
		2'6"-Sh.,silty with 30% thin ss. lenticles.		
74	70		Flabellammina G45-3-145-A	1
			" undiff.	2
			Haplophragmoides G46-1-10-A	8
			" G45-3-145-B.	4
			Textularia G45-5-220-A	1
		6'-Sh., as above.		
80	64		Flabellammina sp.	1
			Haplophragmoides undiff.	3
		2'-Sh.,silty, and very fine ss. lenticles with sdy. ironstone at top and bottom.		
		2'11"-Sh.,silty, thin-bedded with 20% interbedded ss.		
85	59		Flabellammina G45-3-50-A	1
			Haplophragmoides sp.	1
		6'-Sh., as above.		
91	53		Flabellammina sp.	1
		4'6"-Sh., silty,thinly bedded with tuffaceous siltstone lenticles.		
		1"-Tuff, silty, well-bedded.		
		1'5"-Sh.,silty, with thin lenticles of fine, cal. ss.		
		4'6"-Ss., fine and silty shales, interbedded 50-50, beds $\frac{1}{4}$" to $\frac{1}{2}$" thickness.		
101	43		Negligible.	
		6'-Ss. and Sh., as above.		
107	37		Nil	
		6'-Ss. and Sh., as above.		
113	31		Nil	

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* Loc. S47-36.

Sample footage (Footage below* White Chalcedonic Bed)	Footage above Pouce Coupe Ss.	Lithology	Foraminifera Identified
		1'6"-Sh.,silty,with ironstone,ss. and grit lenticles.	
		4"-Ss.,medium coarse, unevenly bedded, salt and pepper appearance,with some pebbles.	
		2'-Sh.,silty with ss.lenticles	
		1'-Sh., silty.	
118	26		Flabellammina G45-3-145-A.... 10 " undiff......... 8
		6'-Sh., silty.	
124	20		Flabellammina G45-3-145-A.... 8 Haplophragmoides sp.......... 1
		4"-Sh., silty.	
		------ Water Level.	

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* Loc. S47-36.

APPENDIX II

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RELATIVE ABUNDANCE OF FORAMINIFERAL GROUPS

IN THE CENTRAL AND LOWER PARTS OF THE KASKAPAU FORMATION

AT SPIRIT RIVER ALBERTA

FORAMINIFERA	Upper Cenomanian Ammobaculites ST-930-A Zone Gaudryina ST-876-A Zone Ammobaculites ST-747-A Zone Very near shore Cool water Percentage of total specimens			Lower Turonian Haplophragmoides ST-664-A Zone Shallow Neritic Cool water Percentage of total specimens			Lower Turonian Pelagic Microfaunal Zone Neritic Percentage of total pecimens		
	Family	Subfamily	Genus	Family	Subfamily	Genus	Family	Subfamily	Genus
Family Trochamminidae	84.7			74.0			.7		
Subfamily Trochammininae		20.5			21.9				
Trochammina			20.5			21.9			
Subfamily Placopsilininae		64.2			52.1			.7	
Ammobaculites			18.0						
Ammomarginulina			4.3						
Flabellammina			2.2						
Haplophragmoides			39.7			52.1			.7
Family Ataxophragmiidae	9.1			8.5					
Subfamily Verneuilininae		9.1			8.5				
Dorothia			2.2						
Gaudryina			2.6						
Tritaxia			.9			8.5			
Verneuilina			3.4						
Family Textulariidae	2.0								
Subfamily Textulariinae		2.0							
Spiroplectammina			1.1						
Textularia			.9						
Family Astrorhizidae	.6								
Subfamily Proteonininae		.6							
Proteonina			.6						
Family Orbulinidae							32.3		
Globigerina									32.3
Family Heterohelicidae	2.8			17.3			67.0		
Subfamily Gumbelininae		2.8			17.3			67.0	
Gumbelina									23.2
Gumbelitria			2.8			17.3			43.8
All Others	.8	.8	.8	.2	.2	.2			
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100.0

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